North Carolina Department of Transportation
Statewide Planning Branch
Systems Studies Unit

Thoroughfare Plan for Macon County

January 1997

Thoroughfare Plan
for
Macon County, North Carolina

Prepared by the:

Statewide Planning Branch
Division of Highways
N. C. Department of Transportation

In Cooperation with:

The County of Macon
The Federal Highway Administration
U. S. Department of Transportation

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3/31/97

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1. Introduction

The economic growth of a region can be greatly influenced by how efficiently the transportation system handles travel demands. If the system fails to provide the means for quick and convenient transportation of people and goods, the region's economic growth becomes stagnated and fails to reach its full potential. It is necessary that such a system not only meet existing travel demands; but, that it also keep pace with the development of the region. This report will set forth a system of thoroughfares to serve the anticipated traffic and land development needs of Macon County for the next thirty-one years. In the development of the system of thoroughfares, certain priorities shall be established based on maintenance needs, inadequate bridges, poor horizontal and vertical alignment, and insufficient present and future capacity.

The system of proposed thoroughfares was developed following the basic principles of thoroughfare planning as described in Appendix A of this report. Major thoroughfares were located based upon existing and anticipated travel demands, existing streets, and field investigations. The plan advocates those improvements that are essential for proper traffic circulation within the current planning period (1994-2025).

Most of the proposed improvements in the county thoroughfare plan will be primarily the responsibility of the North Carolina Department of Transportation. However, Macon County can provide assistance in the implementation of the plan through subdivision regulations and zoning ordinances. With the different governmental agencies involved in developing the thoroughfare system, coordination of activities is of prime importance. The County Commissioners and the North Carolina Board of Transportation have mutually adopted the Macon County Thoroughfare Plan and it is expected to serve as an official guide in providing a well coordinated, adequate, and economical major street system.

GEOGRAPHIC LOCATION MAP

FOR

MACON COUNTY

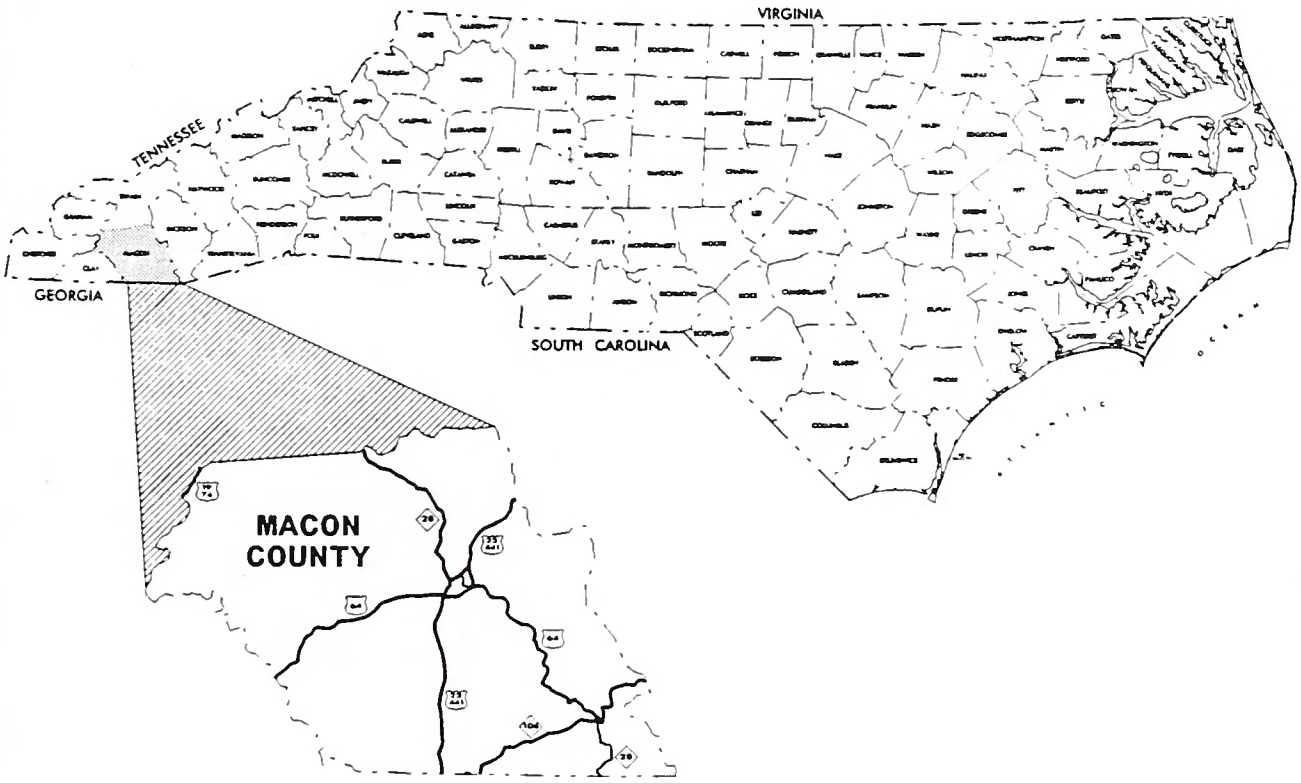


FIGURE 1

2. Thoroughfare Plan Recommendations

The thoroughfare plan for Macon County is shown in Figure 2 and detailed in Appendix B, Table 10. Elements of the plan are initially classified as urban or rural. The areas around Franklin and Highlands are delineated as urban thoroughfare planning areas. A mutually approved thoroughfare plan exists between NCDOT and the Town of Franklin. The Town of Highlands has an non-adopted thoroughfare plan that is currently being revised.

Only major thoroughfares, classified as existing or proposed, are shown within the urban thoroughfare planning area in Figure 2. This is necessary due to the limited amount of detail that can be shown on the county level.

Recommendations of the Macon County Thoroughfare Plan are as follows:

Principal Arterials

1. US 19/74 has 3 lanes and is 9.6 meters wide (32 ft) from Swain County to just south of Wayah Bald Road (SR 1310). The remaining section is 2 lanes and 6.0 meters wide (20 ft) to the Cherokee County line. This road should be widened to 9.8 meters (36 ft) in the 3 lane section and 7.2 meters (24 ft) in the 2 lane section. This widening will improve the functional design and enhance the safety of this facility.

2. US 23/441 is a 4 lane facility from Jackson County to the interchange with US 64. It is 5 lanes from this interchange to the Georgia State Line. No improvements to this facility are deemed necessary prior to the design year (2025).

Minor Arterials

1. US 64 is a 2 lane facility from Jackson County to the interchange with US 23/441 and from SR 1448 to Clay County. The section from the interchange with US 23/441 to SR 1448 is a 4 lane freeway. The 2 lane section from Jackson County to Cold Mountain Road (SR 1538) should be widened to 7.2 meters (24 ft) to improve the functional design and enhance safety. It is recommended that the 2 lane section from the northwest Highlands Planning Area Boundary (HPAB) to Ellijay Road (SR 1001) be widened to 7.2 meters (24 ft) and/or that safety improvements be made where feasible and prudent. The section from Ellijay Road (SR 1001) to Bethel Church Road (SR 1517) should be widened to 5 lanes to meet the future traffic demand and to complement the proposed widening within the Franklin Planning Area. This widening is needed to accommodate the expanding suburban development form the Franklin Area. This recommendation is opposed by many of the citizens that reside or operate businesses along this section of Highlands Road. The County Commissioners stated that they believe that a 3 lane facility would be adequate in this area. After reevaluating this section, a 5 lane cross section is still recommended. However, I believe that the County could delay the need for widening this facility by requiring new development projects to widen the existing roadway to include a left

turn lane. Other zoning and development restrictions in this area could also hold the future traffic demand within the capacity of the existing facility.

Major Collectors

1. NC 28 is 2 lane facility from the Georgia State Line south of Highlands to the Swain County Line. The section of NC 28 from the Georgia State Line to southern HPAB is not anticipated to exceed capacity during the planning period. The section of NC 28 between Highlands and Franklin is concurrently signed with US 64; refer to number 1 under Minor Arterials for this section's recommendations. The remainder of NC 28 from Jim Berry Road (SR 1328) to the Swain County Line should be improved to a 2 lane 7.2 meter (24 ft) facility. This could be done through a combination of minor widening, and building sections on new location.

2. NC 106 is a 2 lane facility from the Georgia State Line to the Town of Highlands. This facility should be widened to 7.2 meters (24 ft) from the Georgia State Line to just southwest of Glen Falls Road (SR 1618). This widening will improve the functional design and enhance the safety of this facility.

3. Wayah Bald Road (SR 1310) is not anticipated to exceed capacity during the planning period. This facility is signed as Bike Route 2, which means that it may be subject to more bicycle traffic than other roads of similar design. Due to the shared, or multi-modal use of this facility; it is recommended that it be improved to the Typical Cross Section "O" as shown in Appendix C.

4. Junaluska Road (SR 1400) is not anticipated to exceed capacity during the planning period. This facility is signed as Bike Route 2, which means that it may be subject to more bicycle traffic than other roads of similar design. Due to the shared, or multi-modal use of this facility; it is recommended that it be improved to the Typical Cross Section "O" as shown in Appendix C.

5. Dicks Creek Road (SR 1401) is not anticipated to exceed capacity during the planning period. This facility is signed as Bike Route 2, which means that it may be subject to more bicycle traffic than other roads of similar design. Due to the shared, or multi-modal use of this facility; it is recommended that it be improved to the Typical Cross Section "O" as shown in Appendix C.

6. Murphy Road (SR 1442) is not anticipated to exceed capacity during the planning period. This facility is signed as Bike Route 2, which means that it may be subject to more bicycle traffic than other roads of similar design. Due to the shared, or multi-modal use of this facility; it is recommended that it be improved to the Typical Cross Section "O" as shown in Appendix C.

7. West Old Murphy Road (SR 1448) should be widened to a minimum of 6.6 meters (22 feet) to improve the functional design and enhance safety. The remainder of this facility is a local road and it is discussed on page 8, as item number 3.

Minor Collectors

1. Ellijay Road (SR 1001) is not anticipated to exceed capacity during the planning period. This facility is signed as Bike Route 2, which means that it may be subject to more bicycle traffic than other roads of similar design. Due to the shared, or multi-modal use of this facility; it is recommended that it be improved to the Typical Cross Section "O" as shown in Appendix C.

2. Mulberry Road (SR 1104) should be widened to a minimum of 6.0 meters (20 feet) to improve the functional design and enhance safety.

3. Coweta Church Road (SR 1115) should be widened to a minimum of 6.6 meters (22 feet) to improve the functional design and enhance safety.

4. Addington Bridge Road (SR 1122) should be widened to a minimum of 6.6 meters (22 feet) to improve the functional design and enhance safety.

5. South Skeenah Road (SR 1128) should be widened to a minimum of 6.6 meters (22 feet) to improve the functional design and enhance safety.

6. Sanderstown Road (SR 1335) should be widened to a minimum of 6.6 meters (22 feet) to improve the functional design and enhance safety.

7. Middle Burnington Road (SR 1372) should be widened to a minimum of 6.6 meters (22 feet) to improve the functional design and enhance safety.

8. Iotla Gap Road (SR 1387) should be widened to a minimum of 6.6 meters (22 feet) to improve the functional design and enhance safety.

9. Airport Road (SR 1434) should be widened to a minimum of 6.6 meters (22 feet) to improve the functional design and enhance safety.

10. Mud Creek Road (SR 1628) should be widened to a minimum of 6.6 meters (22 feet) to improve the functional design and enhance safety.

11. Tessentee Road (SR 1636) should be widened to a minimum of 6.6 meters (22 feet) to improve the functional design and enhance safety.

12. Hickory Knoll Road (SR 1643) should be widened to a minimum of 6.6 meters (22 feet) to improve the functional design and enhance safety.

13. McCoy Road (SR 1653) should be widened to a minimum of 6.6 meters (22 feet) to improve the functional design and enhance safety.

14. Wells Grove Church Road (SR 1667) is not anticipated to exceed capacity during the planning period. This facility is signed as Bike Route 2, which means that it may be subject to more bicycle traffic than other roads of similar design. Due to the shared, or multi-modal use of this facility; it is recommended that it be improved to the Typical Cross Section "O" as shown in Appendix C.

15. Fulton Road (SR 1668) is not anticipated to exceed capacity during the planning period. This facility is signed as Bike Route 2, which means that it may be subject to more bicycle traffic than other roads of similar design. Due to the shared, or multi-modal use of this facility; it is recommended that it be improved to the Typical Cross Section "O" as shown in Appendix C.

Bike Routes

The recommended cross-sections for the facilities designated as Bike Routes are generalized standards. When considering the actual widening of these facilities the Office of Bicycle and Pedestrian Transportation (NCDOT) should be consulted. They can help determine the most appropriate cross-section for the widening. They may also provide assistance in identifying the need for bicycle route improvements based on present and projected bicycle traffic. The coordinator of this branch should be contacted for further assistance.

Bicycle and Pedestrian Program
N. C. Department of Transportation
P. O. Box 25201
Raleigh, NC 27611

Local Roads

1. Norton Road (SR 1110) should be widened to a minimum of 6.0 meters (20 feet) to improve the functional design and enhance safety.

2. Skeenah Road (SR 1127) should be widened to a minimum of 6.6 meters (22 feet) to improve the functional design and enhance safety.

3. Charles Nolen Road (SR 1448) should be widened to a minimum of 6.6 meters (22 feet) to improve the functional design and enhance safety.

4. Walnut Creek Road (SR 1533) should be widened to a minimum of 6.6 meters (22 feet) to improve the functional design and enhance safety.

5. Buck Creek Road (SR 1535) should be widened to a minimum of 6.0 meters (20 feet) to improve the functional design and enhance safety.

6. Cold Mountain Road (SR 1538) should be widened to a minimum of 6.0 meters (20 feet) to improve the functional design and enhance safety.

7. Hale Ridge Road (SR 1625) should be widened to a minimum of 6.0 meters (20 feet) to improve the functional design and enhance safety.

8. Prentice Road (SR 1649) should be widened to a minimum of 6.0 meters (20 feet) to improve the functional design and enhance safety.

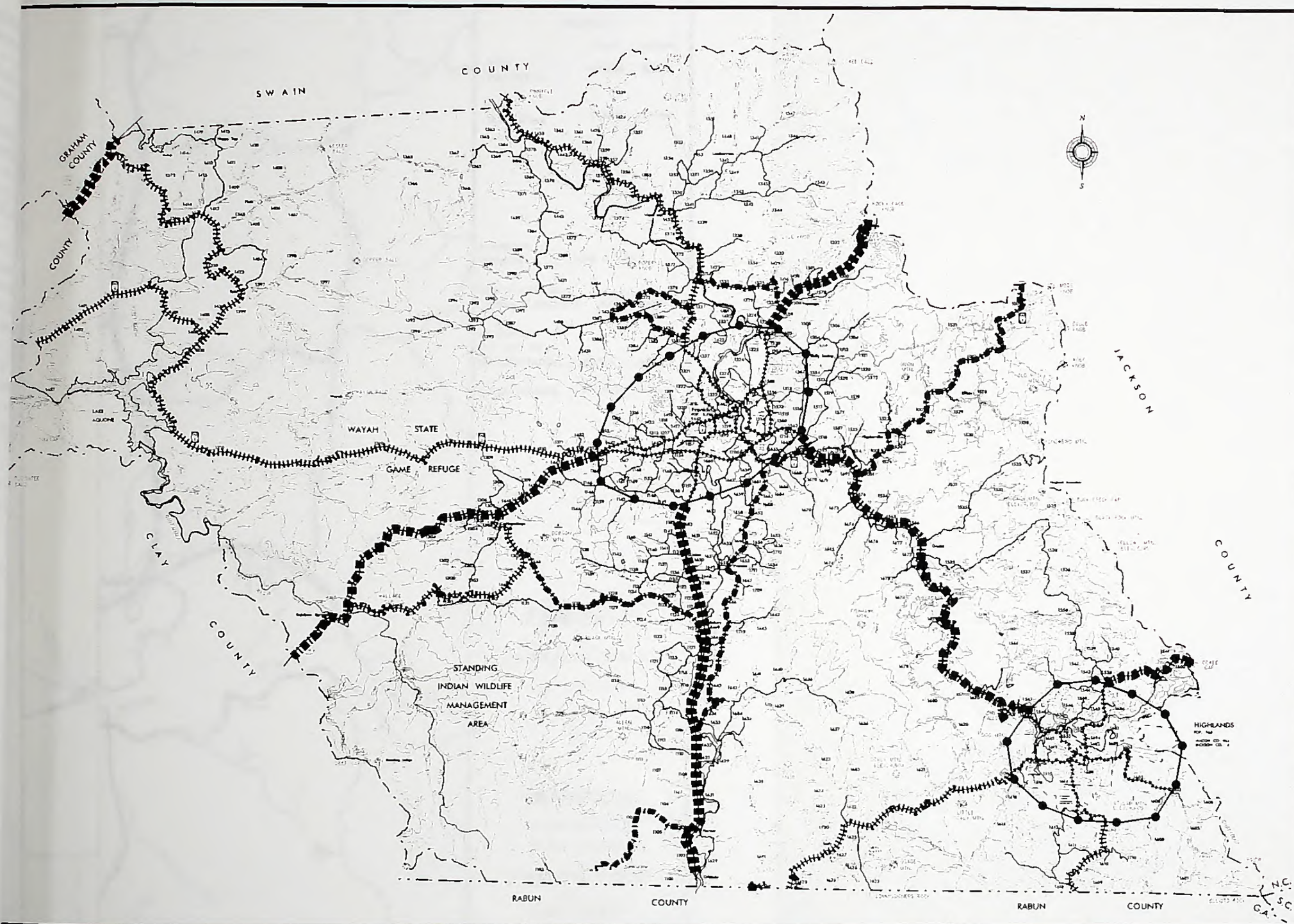
9. Wide Horizon Road (SR 1652) should be widened to a minimum of 6.0 meters (20 feet) to improve the functional design and enhance safety.

Urban Thoroughfare Plans in Macon County

Thoroughfare planning is the process used by public officials to assure the development of the most logical and appropriate street system to meet the existing and future travel desires within the urban area. It is essential that the Municipalities and the County cooperate in developing a system for safe and efficient travel within, and beyond the county.

The Thoroughfare Plan for the Town of Franklin was updated and mutually adopted by the Town and the NCDOT Board of Transportation in 1994. A copy of this plan is shown in Figure 3. A copy of the Thoroughfare Plan Report can be obtained from the Town of Franklin.

A Thoroughfare Plan was developed for the Town of Highlands in 1991. This plan was not adopted by Highlands. A revision of this plan is currently underway. Figure 4 shows the Recommended Highlands Thoroughfare Plan.



LEGEND

EXISTING	PROPOSED	
		Interstate
		Other Principal Arterial
		Minor Arterial
		Major Collector
		Minor Collector
		Urban Freeway
		Urban Major Thoroughfare
		Urban Planning Area

ADOPTED BY:

MACON COUNTY PUBLIC HEARINGS	September 10, 1996 August 12, 1996
RECOMMENDED BY STATEWIDE PLANNING	October 8, 1996
N.C. DEPARTMENT OF TRANSPORTATION	November 1, 1996

April 10, 1996

FIGURE 2

THOROUGHFARE PLAN

MACON COUNTY
NORTH CAROLINA

PREPARED BY THE
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
STATEWIDE PLANNING BRANCH

IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

SCALES

0 1 2 4 6
miles

0 2 4 8 12
kilometers

LEGEND

	EXISTING	PROPOSED
Major Thoroughfare	▬▬	▬ ▬
Minor Thoroughfare	▬	- -

Adopted By
FRANKLIN JUNE 6, 1994

Recommended by
STATEWIDE PLANNING JUNE 29, 1994

Adopted By
N.C. DEPT. OF
TRANSPORTATION AUGUST 5, 1994

PUBLIC HEARING FEBRUARY 22, 1994

FIGURE 3

THOROUGHFARE PLAN

MAY 11, 1994

FRANKLIN

MACON COUNTY

NORTH CAROLINA

PREPARED BY
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
DIVISION OF HIGHWAYS-STATEWIDE PLANNING BRANCH

IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

LEGEND

	EXISTING	PROPOSED
MAJOR THOROUGHFARE	▬▬▬	▮▮▮▮▮
MINOR THOROUGHFARE	▬▬▬	▪▪▪▪▪

PROPOSED GRADE SEPARATION

ADOPTED BY:

TOWN OF HIGHLANDS _____
MACON COUNTY _____
PUBLIC HEARINGS _____
_____
_____

RECOMMENDED BY STATEWIDE PLANNING _____

N.C. DEPARTMENT OF TRANSPORTATION _____

DECEMBER 13, 1996

FIGURE 4

THOROUGHFARE PLAN

HIGHLANDS

MACON COUNTY
NORTH CAROLINA

PREPARED BY THE

NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
STATEWIDE PLANNING BRANCH

IN COOPERATION WITH THE

U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

SCALES

0 0.5 1.0
miles

0 1 2
kilometers

3. Existing and Projected Conditions

Factors Affecting Transportation

The objective of thoroughfare planning is to develop a transportation system which will enable people and goods to travel safely and economically. To determine the needs of a county; population, land use, and traffic must be examined. To properly plan for the transportation needs, it is important to understand and describe the type and amount of travel which takes place in that area, and also to clearly identify the goals and objectives to be met by the thoroughfare plan.

In order to fulfill the objectives of an adequate 31-year thoroughfare plan, reliable forecasts of future travel patterns must be achieved. Such forecasts are possible only when the following major items are carefully analyzed: (1) historic and potential population changes; (2) significant trends in the economy; (3) character and intensity of land development; and (4) motor vehicle registration and usage. Additional items that vary in influence include the effects of legal controls such as zoning ordinances and subdivision regulations, availability of public utilities, transportation facilities, topographic and other physical features of the urban area.

Population Trends

The volume of traffic on a section of roadway is a function of the size and location of the population it serves. An analysis of population is one of the first steps for transportation planning. The analysis of past trends allows the planner to estimate future population and the traffic that it will generate with some degree of reliability.

From 1970 to 1994 the population of Macon County has grown approximately 1.15 percent per year; slightly greater than North Carolina's growth rate of 1.08 percent per year for the same period. This growth trend is due to the expansion of residential development, the increase in employment opportunities, and the rise in popularity of the region as a resort and retirement community. The remainder of the planning period should see a continuation of this growth trend in Macon County.

Table 1 shows the historical and projected populations for North Carolina, Macon County, Franklin, and Highlands. Table 2 shows the percent change in population for North Carolina, Macon County, Franklin, and Highlands.

Table 1 Population							
	Year						
Location	1970	1980	1990	2000	2010	2020	2025
North Carolina	5,084,411	5,880,095	6,632,448	7,713,383	8,543,312	9,345,967	9,815,047
Macon County	15,788	20,178	23,499	28,507	31,647	34,259	36,305
Franklin	2,336	2,640	2,873	---	---	---	---
Highlands	583	653	948	---	---	---	---

Source: Office of State Planning

Table 2 Percent Change in Population						
Location	1970-1980	1980-1990	1990-2000	2000-2010	2010-2020	2020-2025
North Carolina	+15.6	+12.8	+16.3	+10.8	+9.4	+5.0
Macon County	+27.8	+16.5	+21.3	+11.0	+8.2	+8.3
Franklin	+13.0	+8.8	---	---	---	---
Highlands	+12.0	+45.2 *	---	---	---	---

* This dramatic increase due to a 1980 annexation that roughly doubled the land area of Highlands.

Employment

The largest employment sectors in Macon County are the service and retail trade industries. Twenty-four percent of the 1990 labor force worked in the service industry and almost 23 percent were employed in the retail trade industry. The construction and manufacturing industries, each with approximately 13 percent of the 1990 labor force, are also significant employment sectors. The trend toward more retail trade and service employment is expected to continue in Macon County. The evolution of Macon County as a retirement and resort area should continue to drive this trend. The growth in tourism to explore the natural beauty of Macon County will also contribute to this trend. Table 3 contains a breakdown of the employment sectors in Macon County for 1990 and 2020.

Table 3
Employment Trends In Macon County

Employment Classification	1990 Employees	1990 Percent	2020 Employees	2020 Percent
Agriculture	360	3.4	270	1.7
Manufacturing	1366	12.7	1740	11.2
Non-manufacturing	9011	83.9	13570	87.1
Agricultural Services, Forestry, Mining	206	1.9	350	2.2
Construction	1384	12.9	1830	11.8
Transportation, Commerce, and Public Utilities	398	3.7	550	3.5
Retail Trade	2449	22.8	4770	30.6
Wholesale Trade	120	1.1	240	1.5
Finance, Insurance, and Real Estate	553	5.2	510	3.3
Services	2577	24.0	3780	24.3
Government	1324	12.3	1540	9.9

Sources: Regional Economic Information System, US Department of Commerce, June 1996
1996 State Profile North Carolina, Woods & Poole Economics, Inc., December 1995

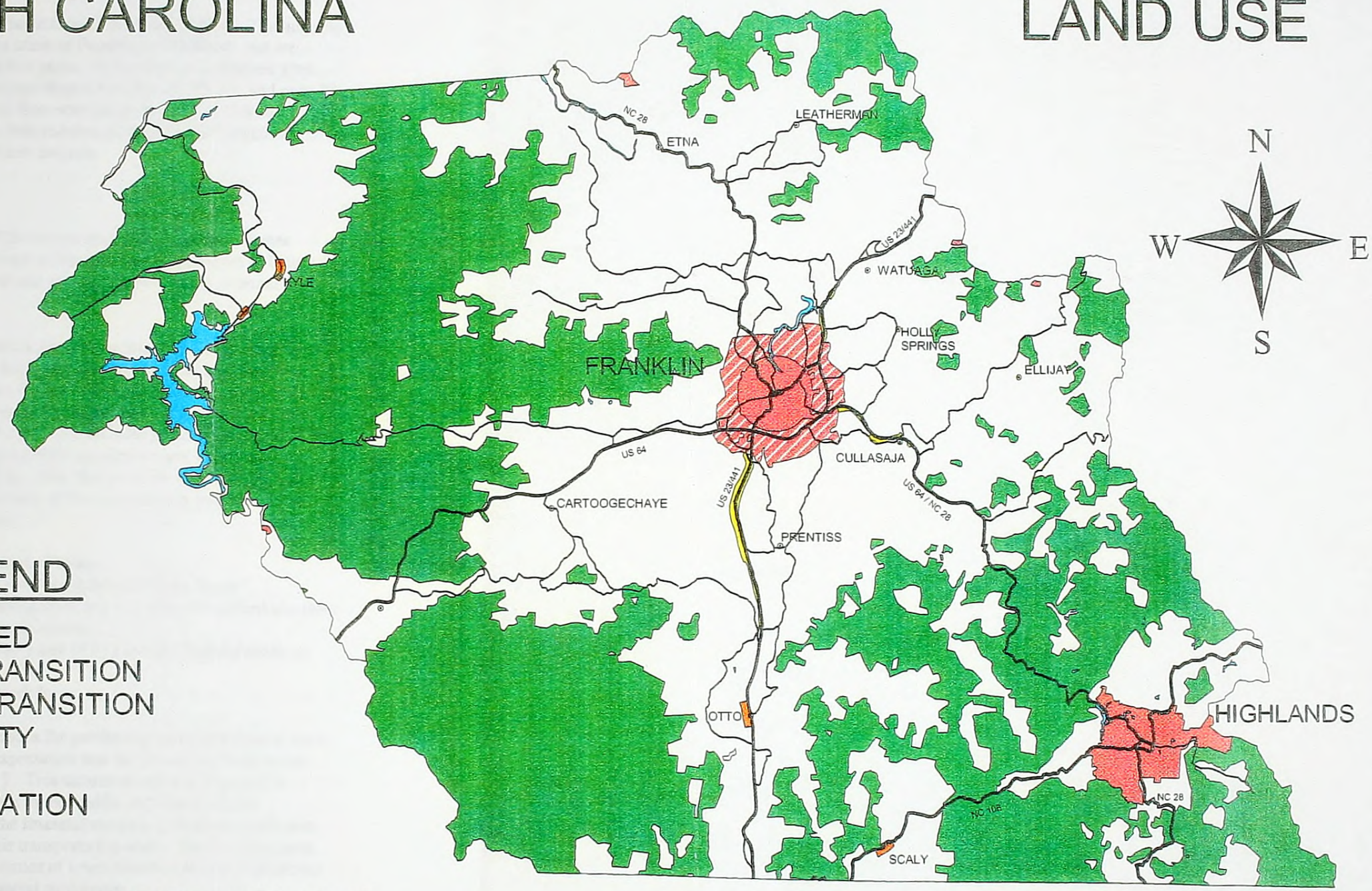
Land Use

The generation of traffic on a particular street is very closely related to the utilization of adjacent land areas. Some types of land use generate much more traffic than others. For example, a commercial or retail area such as a shopping center would generate or attract much larger volumes of traffic than a residential area. The attraction between different land uses varies with the intensity of the development and the distance between those developed areas. Therefore, it becomes necessary to designate land uses by type for the purposes of transportation planning. An analysis of the distribution of existing land uses serves as a basis for forecasting future land use needs and resulting travel patterns. Figure 5 shows the existing land uses for Macon County.

Although Macon County is predominately a rural county, the development of the land surrounding the urban areas of Franklin and Highlands is projected to continue. Also, increased commercial development is anticipated along the US 23/441 corridor northeast and south of Franklin. The Highlands Road area from US 23/441 Bypass to Ellijay Road area will also continue to experience residential and commercial growth. Much of the new growth in Macon County will be driven by the continued evolution of Macon County as a tourism and retirement destination.

MACON COUNTY NORTH CAROLINA

EXISTING LAND USE



LEGEND

- DEVELOPED
- URBAN TRANSITION
- LIMITED TRANSITION
- COMMUNITY
- RURAL
- CONSERVATION

- LAKES
- PRIMARY US AND STATE HIGHWAYS
- SECONDARY ROADS

NOT TO SCALE

FIGURE 5

Historically Significant Land

There are over 90 sites of historic importance located in Macon County. The majority of these sites are located within the planning areas of Franklin or Highlands and are discussed in their respective urban thoroughfare plans. Of the remaining historic sites located in Macon County; one is on the National Register of Historic Places, and over 30 are on the state study list. Although some of these sites are in close proximity to recommended highway improvements, it is believed that avoidance and mitigation practices can minimize or eliminate any adverse impacts.

Traffic

A comparison of 1994 and projected 2025 average annual daily traffic volumes (AADT) on selected major roads and highways in Macon County are shown in Figure 6. The projected AADT was based on historical and anticipated population, economic growth patterns and land use trends.

Vehicle registration has increased at a much greater rate than population since 1940. The increase can best be shown by a graph displaying the change in the persons per vehicle ratio over a period of time. This ratio is obtained by dividing the total population of the area by the total number of vehicles registered in that area. Figure 7 shows this comparison for North Carolina and Macon County and includes projections to 2025. The results illustrate the transition from a non-automobile oriented society to one whose vitality is heavily dependent on the automobile. This change in life style has gradually occurred over many years, with the most dramatic difference between 1940 and 1960. This is primarily due to the following reasons:

1) The post-depression increase in the standard of living.
2) The increase in population including the post World War II "Baby Boom".
3) The transition from an agriculturally dominated society to a more diversified one (less people on the farm, but more need for transportation).
4) The availability of automobiles in the 1960's and 1970's and the banking credit to buy them (more cars easier credit).
5) The increased number of women in the work force.

Since the early 1970's however, these reasons for purchasing more automobiles have become less influential and have led to the expectation that the person per vehicle rate will begin to stabilize as projected in Figure 7. This saturation effect is expected to stabilize trip-making characteristics of families in the middle and upper income categories due to the fact they already have the financial means to purchase a sufficient number of vehicles to satisfactorily serve their transportation needs. On the other hand, moderate growth in the trip making characteristics of lower income families is projected due to an expected improvement in their financial well-being.

Capacity, Width, and Alignment Deficiencies

North Carolina's standard for highway construction calls for 3.3 meter (11 ft) lanes on all highways with traffic volumes greater than 2000 ADT (Average Daily Traffic) or design speeds greater than 80 kilometers per hour, including all primary arterials. A minimum lane width of 2.7 meters (9 ft) can be tolerated on collector roads with an ADT of less than 400 vehicles per day. Minimum level of service for minor collector roads dictate a 40 mph average overall travel speed during peak traffic conditions.

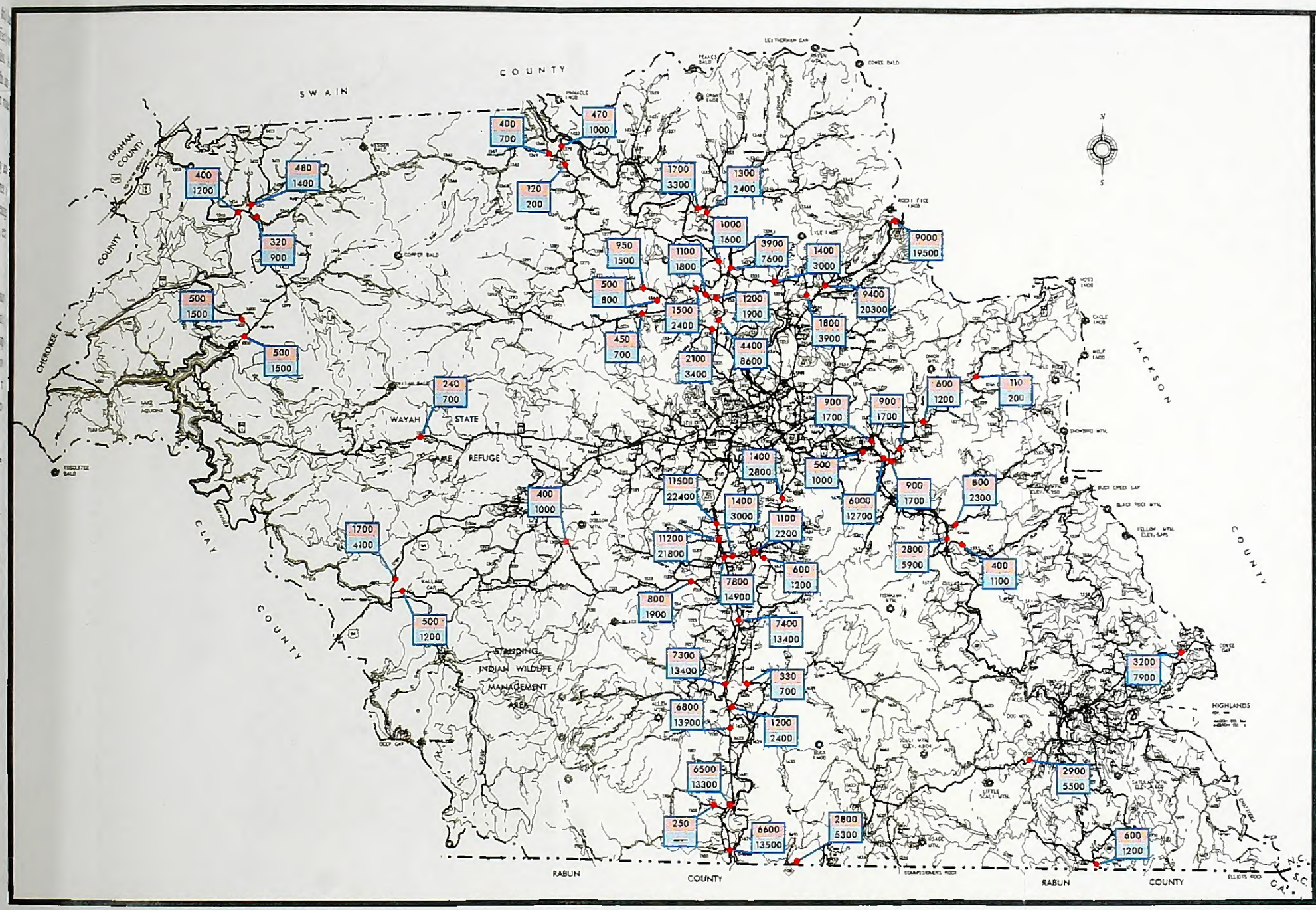
Design requirements for thoroughfares vary according to the desired capacity and level of service to be provided. Universal standards in the design of thoroughfares are not practical. Each road or highway section must be individually analyzed and its design requirements determined on the basis of the amount and type of projected traffic, existing capacity, desired level of service, and availability of right-of-way.

The level of service is a function of the ease of movement experienced by motorists using the facility. The ability of a motorist to drive at a desired speed is dependent upon the control devices, the influence and character of traffic generated by abutting property, and imposed speed restrictions. The level of service is generally indicated by the overall travel speed experienced by traffic. Recommended minimum levels of service for roads and highways included in the proposed Macon County Thoroughfare Plan are given in table 4.

Table 4
Minimum Levels of Service for Roads and Highways

Facility	Overall Travel Speed During Peak Traffic Conditions
Principal and Minor Arterials	80-90 km/h
Major Collector Roads	70-80 km/h
Minor Collector Roads	60 km/h

From the standpoint of driver convenience, ease of operations, and safety, it would be desirable to widen all existing roads and highways to provide a minimum lane width of 3.6 meters (12 ft). However, when considering overall statewide needs and available highway revenues, it is found that these levels of improvement applied statewide would be impractical. It is necessary, therefore, to establish minimum tolerable widths for existing roads with respect to traffic demands which would be economically feasible. Table 5 gives the widths used in determining the existing lane deficiencies in the County.



LEGEND

1994	1994 Average Daily Traffic
2025	2025 Average Daily Traffic

FIGURE 6

CURRENT AND PROJECTED AVERAGE DAILY TRAFFIC

MACON COUNTY
NORTH CAROLINA

PREPARED BY THE
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
STATEWIDE PLANNING BRANCH

IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

SCALES

0 1 2 4 6 miles

0 2 4 8 12 kilometers

Figure 7
Macon County vs. North Carolina
Persons per Vehicle

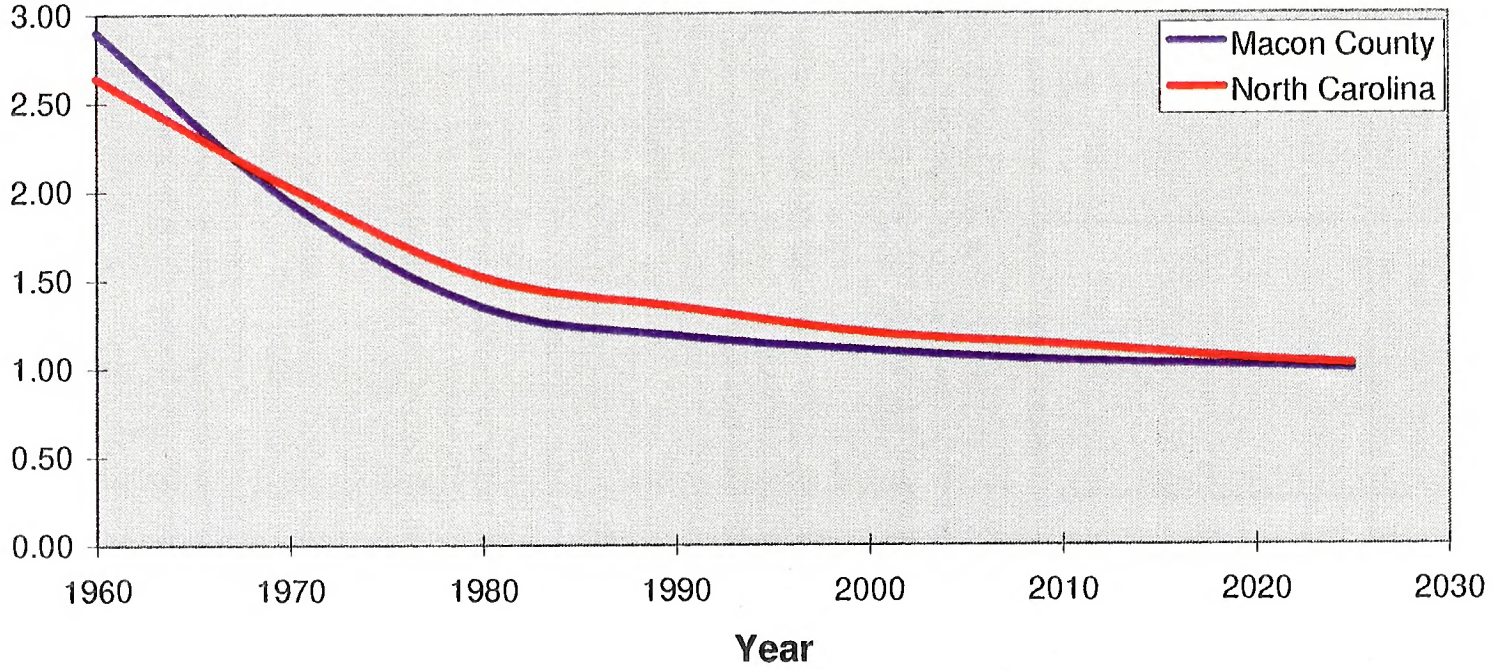


Table 5 Minimum Tolerable Lane Widths						
Average Daily Traffic (ADT)	Principal Arterials		Minor Arterials		Collectors	
	meters	feet	meters	feet	meters	feet
Over 2000	3.3	11	3.3	11	3.3	11
400 - 2000	3.3	11	3.0	10	3.0	10
100 - 400	3.3	11	3.0	10	2.7	9
Below 100	3.3	11	3.0	10	2.7	9

An analysis of roads in Macon County was made to determine if the projected traffic (year 2025) would exceed the practical capacity of the system. Based on this analysis only two facilities in Macon County were projected to exceed their practical capacities within the design period.

1. US 23/441 was projected to exceed the capacity of the two lane section between Franklin and the Georgia State Line. However, construction to widen this facility to five lanes was underway at the beginning of this study and has since been completed. The design year traffic projections are not anticipated to exceed the new capacity of this improved highway.

2. Future traffic on a short section of US 64 from Ellijay Road (SR 1001) to the Franklin Planning Area Boundary (PAB) is expected to meet or exceed the capacity of this facility. Anticipated development pressures along this section of US 64 and along adjoining roads is responsible for this future traffic demand. If anticipated development does not occur or if it is restricted by zoning or other legislation, the design year traffic demand may not exceed the current capacity of the facility.

There are a number of roads in the County that have substandard widths. Standards established in Table 5 were used in the analysis. The width needed to bring these roads up to standard are given as the recommended cross section in Appendix B. Because of the substantial cost of upgrading all secondary roads to standard; narrow widths may have to be tolerated until sufficient funds are available to provide for improvements.

Traffic Safety

Records of traffic accidents are of assistance in locating problem areas on the highway system. The 1994 safety program listing, obtained from the Traffic Engineering Branch of the North Carolina Department of Transportation, is a tabulation of accident locations throughout the state.

Traffic accident data for the period from January, 1991, through December, 1994, was analyzed as part of the development of the thoroughfare plan. Certain prevailing conditions are: intersections geometrics, sight distance, signalization, road conditions, weather, light conditions, driver's conditions and accident type. While no accidents are desired, a certain number are apparently unavoidable due to certain conditions.

An inspection of the accident locations in Macon County resulted in the following recommendations:

Intersection of
US 23/441 and Coweta Church Road (SR 1115)

The accidents at this location are left turning accidents and rear end accidents. The widening of US 23/441 should reduce these accidents by providing a left turn lane. This will remove turning vehicles from the travel way and reduce the conflicts associated with turning vehicles. It should also provide improved sight distance at the intersection.

Intersection of
US 23/441 and Jones Ridge Road (SR 1150)

The accidents at this location are mostly rear end accidents. Again, the widening of US 23/441 should reduce these accidents by providing a left turn lane.

Intersection of
US 23/441 and Terrell Road (SR 1682)

The accidents at this location are left turning accidents and rear end accidents. The widening of US 23/441 should reduce these accidents by providing a left turn lane. The widening should also improve the sight distance at this intersection.

Intersection of
US 64 and Ellijay Road (SR 1001)

The majority of accidents at this location are rear end accidents. Installing a left turn lane on US 64 should significantly reduce the number of accidents at this location.

Intersection of
NC 28 and Airport Road (SR 1434)

The accidents at this location are rear end accidents and running off the road accidents. This intersection is shown in the picture below.

As you can see in this picture there is a crest vertical curve just north of the intersection with Airport Road. There is also limited sight distance from Airport Road. This poor geometric design and lack of sight distance contribute significantly to the accidents occurring at this location. Improving NC 28 by cutting down the crest vertical curve should help to reduce accidents at this location. The safety of this intersection could be further improved by clearing more land at the corners of the intersection. This provides vehicles on Airport Road with an unobstructed view of traffic on NC 28. This unobstructed area is known as a "sight triangle" in traffic engineering terms. These are the type of improvements that would be made in connection with recommendations for NC 28 on page 6.

Bridge Conditions

Bridges are a vital and unique element of a highway system. First they represent the highest unit investment of all elements on the system. Second, any inadequacy or deficiency in a bridge reduces the value of the total investment. Third, a bridge presents the greatest opportunity of all potential highway failures for disruption of community welfare. Finally, and most importantly, a bridge represents the greatest opportunity of all

highway failures for loss of life. For these reasons, it is imperative that bridges be constructed to the same design standards as the highway system of which they are a part.

The North Carolina Department of Transportation's Bridge Maintenance Unit has been assisted by consultants in inspecting all bridges on the State Highway System. All bridges in Macon County have been analyzed, rated, appraised, and inventoried. The resulting data has been reduced to a more readily usable form as a management tool.

A sufficiency rating is used in the analysis to determine the deficiency of a particular bridge. The sufficiency rating is a federally established standard for determining which bridges qualify for federal funding. Factors considered when calculating the sufficiency rating are: structural integrity, serviceability, functional obsolescence, public use, structure type, and traffic safety features. A bridge with a sufficiency rating less than 80 percent qualifies for federal rehabilitation funds. Also, a bridge with a sufficiency rating less than 50 percent qualifies for federal replacement funds.

The Deficient bridges located in Macon County are shown in Figure 8. A bridge is considered deficient if it is classified as either Structurally Deficient or Functionally Obsolete.

Structurally Deficient bridges are in relatively poor condition, or have insufficient load-carrying capacity. The insufficient load carrying capacity could be due to the original design or to deterioration.

Functionally Obsolete bridges are narrow, have inadequate under-clearances, have insufficient load-carrying capacity, are poorly aligned with the roadway, and can no longer adequately service today's traffic.

Tables 6 and 7 list the Structurally Deficient and Functionally Obsolete bridges in Macon County along with the Sufficiency Rating.

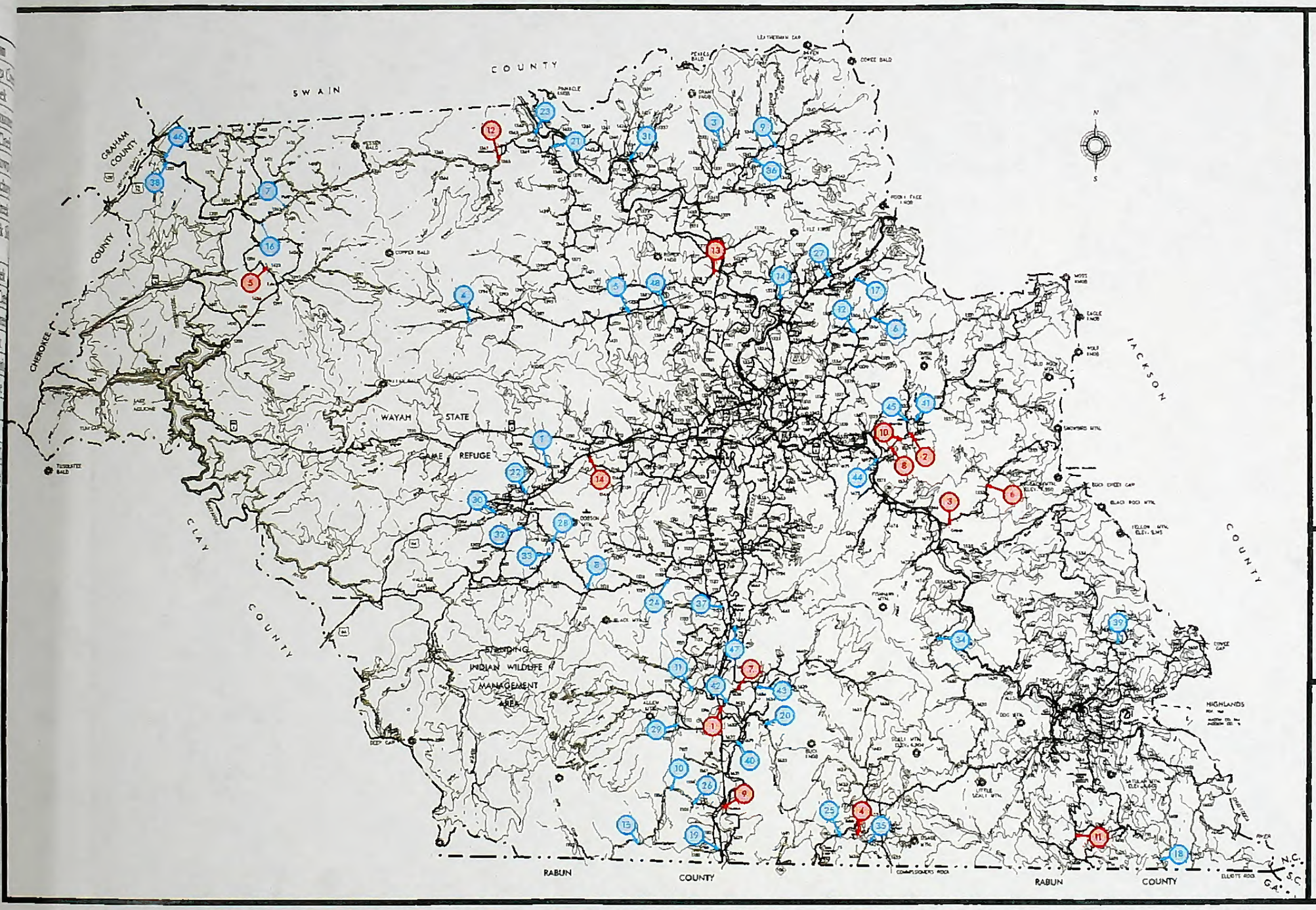
Table 6 Structurally Deficient Bridges in Macon County			
Map Index	Sufficiency Rating	Bridge Number	Location
1 *	33.2	045	SR 1636 over Little Tennessee River
2	33.3	003	SR 1526 over Ellijay Creek
3 *	35.8	200	SR 1533 over Walnut Creek
4	36.9	213	SR 1627 over Mud Creek
5	37.6	320	SR 1423 over White Oak Creek
6	44.1	204	SR 1563 over Walnut Creek
7	45.2	049	SR 1636 over Tessentee Creek
8	46.4	001	SR 1524 over Ellijay Creek
9	47.9	041	SR 1683 over Little Tennessee River
10	48.7	002	SR 1001 over Ellijay Creek
11	53.1	323	SR 1611 over Clear Creek
12	53.6	079	SR 1365 over Tellico Creek
13	54.0	197	SR 1378 over Iotla Creek
14	55.2	015	SR 1439 over Cartoogechaye Creek

* Included in current Transportation Improvement Program

Table 7 Functionally Obsolete Bridges in Macon County			
Map Index	Sufficiency Rating	Bridge Number	Location
1 *	34.9	016	SR 1309 over Cartoogechaye Creek
2	39.2	172	SR 1456 over Little Tennessee River
3	40.3	318	SR 1351 over Matlock Creek
4	42.3	127	SR 1392 over Burningtown Creek
5	42.3	207	SR 1386 over Iotla Creek
6 *	42.5	112	SR 1504 over Rabbit Creek
7	42.9	154	SR 1365 over Otter Creek
8	45.8	099	SR 1128 over Jones Creek
9	46.1	086	SR 1346 over Cowee Creek
10	46.1	114	SR 1104 over Mulberry Creek
11	46.2	052	SR 1114 over Coweeta Creek
12	46.2	069	SR 1504 over Rabbit Creek
13 *	47.0	054	SR 1674 over Cullasaja River
14	47.1	064	SR 1328 over Watauga Creek
15	47.2	115	SR 1104 over Barkers Creek
16	47.2	153	SR 1365 over Otter Creek

* Included in current Transportation Improvement Program

Table 7 Functionally Obsolete Bridges in Macon County			
Map Index	**Sufficiency Rating**	**Bridge Number**	**Location**
17	47.5	214	SR 1500 over Watauga Creek
18	49.5	121	SR 1608 over Big Creek
19	49.5	311	SR 1102 over Commissioner Creek
20	49.7	043	SR 1635 over Middle Creek
21	50.0	076	SR 1370 over Burningtown Creek
22	50.1	018	SR 1307 over Cartoogechaye Creek
23	51.1	078	SR 1364 over Tellico Creek
24	51.1	223	SR 1134 over North Fork Sheenah Creek
25	51.5	026	NC 106 over Middle Creek
26	53.2	248	SR 1105 over Mulberry Creek
27	54.6	128	SR 1501 over Raccoon Creek
28	55.3	344	SR 1448 over Jones Creek
29	55.4	092	SR 1112 over Drymans Fork Creek
30	55.7	243	SR 1306 over Popular Cove Creek
31	55.8	134	SR 1658 over Lakey Creek
32	56.4	020	SR 1303 over Dills Creek
33	57.1	343	SR 1448 over Thompson's Creek
34	58.5	174	SR 1678 over Goldmine Creek
35	58.6	194	SR 1626 over Mud Creek
36	59.9	084	SR 1349 over Cowee Creek
37	63.7	312	SR 1122 over Bates Creek
38	65.1	227	SR 1310 over Nantahala River
39	65.8	060	SR 1540 over Big Creek
40	70.4	050	SR 1632 over Little Tennessee River
41	70.8	004	SR 1001 over Ellijay Creek
42	71.3	241	SR 1636 over Little Tennessee River
43	71.7	319	SR 1684 over Tessentee Creek
44	77.3	105	US 64 over Cullasaja River
45	77.3	302	SR 1001 over Battle Branch
46	78.5	226	SR 1310 over Nantahala River
47	78.9	046	SR 1644 over Little Tennessee River
48	79.9	205	SR 1434 over Iotla Creek



LEGEND

Structurally Deficient Bridge

Functionally Obsolete Bridge
(rating < 50)

FIGURE 8

DEFICIENT BRIDGES

MACON COUNTY
NORTH CAROLINA

PREPARED BY THE
NORTH CAROLINA DEPARTMENT OF TRANSPORTATION
STATEWIDE PLANNING BRANCH

IN COOPERATION WITH THE
U.S. DEPARTMENT OF TRANSPORTATION
FEDERAL HIGHWAY ADMINISTRATION

SCALES

0 1 2 4 6
miles

0 2 4 8 12
kilometers

4. Improvement Priorities

Construction Priorities

Construction priorities depend on the potential that proposed projects have to satisfy various objectives. Some of the most important objectives are:

1) improvement of the State's arterial system;
2) cost effective improvement of the safety and level of service of all roads and highways on the State system;
3) encouragement of economic development;
4) preservation of the environment; and
5) fair and equitable allocation of project funding.

Environmental Concerns

Environmental factors considered in highway project evaluation can be divided into three categories: Physical, Social/Cultural, and Economic. Factors from these categories are utilized in the benefits analysis. These primary environmental factors are shown in Table 8. The relative environmental impact of a project is subjectively measured by summing the positive and negative impacts on various environmental factors.

The potential impact to archeological sites in Macon County is also a concern that must be addressed. After researching the recorded archeological surveys of Macon County it appears that there are a handful of sites that could possibly be impacted by proposed highway projects. These sites may require additional surveys to determine possible impacts. It is believed that most potential impacts can be minimized or eliminated by avoidance and mitigation practices.

The economic impact of a project is an estimate of the probability that the project will stimulate economic growth in the planning area. This probability is subjectively calculated based on knowledge of the project, local development characteristics, and land development potential. The probability of economic development is then rated on a scale of 0.00 (none) to 1.00 (excellent). Table 9 contains the calculated environmental and economic impacts for each of the major projects.

Benefit Analysis

Benefits are determined based on cost savings to the users. The total benefit is the sum of the savings in three categories: Vehicle Operating Costs, Travel Time Costs, and Accident Costs. The reduction in each of these costs is the "project" benefits received by the users. The benefits produced by each project is then compared to the estimated cost of building the project. A benefit/cost analysis was performed on the major projects in the Macon County Thoroughfare Plan. These projects and their benefits are shown in Table 9.

Table 8 Environmental Considerations		
Physical Environmental	**Social and/or Cultural Environment**	**Economic Environment**
Air Quality	Housing	Businesses
Water Resources	Neighborhoods	Employment
Wildlife	Noise	Economic Development
Vegetation	Education Facilities	Public Utilities
	Churches	Transportation Costs
	Park and Recreational Facilities	Capital Costs
	Public Health and Safety	Operation and Maintenance Costs
	National Defense	
	Aesthetics	
	Historic Sites and Landmarks	

Table 9
Macon County Thoroughfare Plan Cost Estimates - Benefits - and Probable Impacts

Description	Construction Cost	ROW [1] Cost	Total [1] Cost	User [1] Benefits	Economic Development	Environmental Impacts Positive	Environmental Impacts Negative
US 64 [2]	7,377	53	7,431	11,013	1.00	0.30	0.30
NC 28	12,746	1,176	13,922	109,462	0.90	0.30	0.25
NC 106	9,277	503	9,780	30,920	0.56	0.25	0.05

Notes - 1 Costs and Benefits are in Thousands of Dollars.

2 No additional ROW is required for this project.

5. Implementation

There are several tools which are available for use by a county to assist in the implementation of a Thoroughfare Plan. They are as follows:

State-County Adoption of Thoroughfare Plan

The Department of Transportation, together with the County, have cooperatively developed and mutually adopted the Macon County Thoroughfare Plan. The mutually adopted plan will serve as a guide to the Department of Transportation in the development of the road and highway system of the County. The approval of the plan by the County will enable standard road regulations and land use controls to be used effectively to assist in the implementation of the plan.

Plan development and official adoption included public participation and a public hearing to ensure that the public was fully informed of the plan, and that their comments were heard and adequately considered.

Future Street Lines

Future streets can be designated by a future street line. Certain requirements are necessary for a future street line ordinance. These requirements include: enabling legislation, detailed description or survey, public hearing, administrative procedure and staff to oversee the process.

The best use of this implementation tool is along existing thoroughfares that will need to be widened in the future. Using future street lines can significantly reduce right-of-way costs over a long period of time. They will also reduce disruption of existing development, and inform property owners of the prospects of future planning.

Subdivision Controls

The subdivision regulations require every subdivider to submit to the county Planning Commission a plan of the proposed subdivision, as well as requiring that the subdivision be constructed to certain standards. Through this process, it is possible to require the subdivision streets to conform to the thoroughfare plan and to reserve or protect necessary rights-of-way for future roads and highways that will become a part of the thoroughfare plan. The construction of subdivision streets to adequate standards will reduce maintenance cost and will ease the transfer of the streets to the State Highway System. Appendix D outlines the recommended design standards for subdivisions.

Zoning Ordinance

The zoning ordinance is beneficial to thoroughfare planning because planned locations of specific land users and their densities can be realized. This provides a degree of stability on which to forecast travel and to plan future streets. Other benefits include: the establishment of standards of development which will aid traffic operation on major thoroughfares, minimize strip commercial development which creates traffic friction and increases the traffic accident potential, the requirement for off-street parking by new development with the purpose of eventual prohibition of all curb parking on major thoroughfares.

Land Use Controls

Land use regulations are an important tool in that they regulate future land development and minimize undesirable development along roads and highways. The land use regulatory system can improve highway safety by requiring sufficient building setbacks to provide for adequate sight distances and by requiring off-street parking.

Planned Unit Development Ordinance

Planned unit development ordinances (PUD) permit flexibility in design of larger developments, with the overall design subject to review. This ordinance can require right-of-way dedication and thoroughfare construction in accordance with the thoroughfare plan. Certain revisions may be necessary to the thoroughfare plan in order to coordinate with the development.

Functional Design

The term "functional design" is used to describe preliminary design work done to answer questions on construction feasibility, to provide better information on right-of-way and construction cost estimates, and to give the administrative agency, developers and property owners a detailed knowledge on proposed alignments. Typically, functional designs are done on topographic mapping and the centerline, horizontal curves, and approximate right-of-way limits are shown to scale. If topographic mapping is not available, functional designs are done on aerial photography or planimetric mapping.

Functional designs are expensive and time consuming and can become outdated quickly due to minor changes and adjustments. For this reason, they should only be done on an "as needed" basis.

Dedication of Right-of-way with Density or Development Rights Transfer

North Carolina General Statutes have been amended to provide this additional tool for plan implementation. The statutes provide that a city or county may require an applicant for subdivision approval (or any other applicant for permission pursuant to a land use control ordinance) to dedicate the right-of-way within a corridor for street or highway purposes. The city or county upon dedication allows the applicant to transfer density

credits, attributable to the dedicated right-of-way, to the contiguous land owned by the applicant.

If the city or county does not require dedication of right-of-way under this section or other legal authority, but an applicant elects to dedicate the needed right-of-way, the city or county may allow the applicant to transfer the density credits, attributable to the dedicated right-of-way, to contiguous land that is part of a common development plan or to transfer severable development rights to noncontiguous land in designated receiving districts.

Funding

The majority of the improvements will require funding by the Transportation Improvement Program. The Board of Transportation regularly conducts public meetings to obtain input form the public of their needs for highway improvements.

However, not all roadway improvements are covered by this procedure. Nearly all secondary road work is done on a county by county basis. These funds (county construction account) are used to pave unimproved roads, widen roadways, stabilize dirt roads, make minor alignment improvement, and even construct short connectors when appropriate. The County Commissioners are encouraged to work with the Division Engineer when the County's priority list is developed. Many of the minor improvements recommended may be realized by using the County's construction account funds and cooperatively developing the County's Priority list with the Division Engineer.

6. Conclusion

The economic growth of a region is largely dependent on the efficiency of its transportation system. Unless people and goods can move from one place to another quickly and conveniently, the area stagnates and fails to reach its full potential. Having recognized this need for an efficient transportation system Macon County and the North Carolina Department of Transportation have cooperatively developed and adopted this thoroughfare plan.

In order for this plan to be an effective tool in implementing an adequate future street network the county must coordinate approval of future land development with the thoroughfare plan. It is also recommended that the growth patterns be monitored over time in order to detect development patterns different than those anticipated during the planning process. As a result, it may be necessary to change the implementation schedule of some of the plan. It may also be necessary to make revisions to the plan in order to accommodate unexpected changes in urban development.

A. Thoroughfare Planning Principles

There are many advantages to thoroughfare planning, but the primary mission is to assure that the road system will be progressively developed to serve future travel desires. Thus, the main consideration in thoroughfare planning is to make provisions for street and highway improvements so that, when the need arises, feasible opportunities to make improvements exist.

Benefits of Thoroughfare Planning

There are two major benefits derived from thoroughfare planning. First, each road or highway can be designed to perform a specific function and provide a specific level of service. This permits savings in right-of-way, construction, and maintenance costs. It also protects residential neighborhoods and encourages stability in travel and land use patterns. Second, local officials are informed of future improvements and can incorporate them into planning and policy decisions. This will permit developers to design subdivisions in a non-conflicting manner, direct school and park officials to better locate their facilities, and minimize the damage to property values and community appearance that is sometimes associated with roadway improvements.

County Thoroughfare Planning Concepts

The underlying notion of the thoroughfare plan is to provide a functional system of streets, roads, and highways that permit direct, efficient, and safe travel. Different elements in the system are designed to have specific functions and levels of service, thus minimizing the traffic and land service conflict.

In the county plan, elements are either urban or rural. In the urban planning area, the local municipality generally has planning jurisdiction. Outside the urban planning area, the county has planning jurisdiction. In those urban areas where no urban thoroughfare plan exists, elements are rural and are under the planning jurisdiction of the county.

Within the urban and rural systems, plan elements are classified according to the specific function they are to perform. A discussion of the elements and functions of the two systems follows.

Thoroughfare Classification Systems

Streets perform two primary functions, traffic service and land access, which when combined, are basically incompatible. The conflict is not serious if both traffic and land service demands are low. However, when traffic volumes are high, conflicts created by uncontrolled and intensely developed abutting property lead to intolerable traffic flow friction and congestion.

The underlying concept of the thoroughfare plan is that it provides a functional system of streets that permit travel from origins to destinations with directness, ease and safety.

Different streets in this system are designed and called on to perform specific functions, thus minimizing the traffic and land service conflict.

Urban Classification

In the urban thoroughfare plan, elements are classified as major thoroughfares, minor thoroughfares, or local access streets.

Major Thoroughfares

These routes are the primary traffic arteries of the urban area providing for traffic movements within, around, and through the area.

Minor Thoroughfares

Roadways classified under this type collect traffic from the local access streets and carry it to the major thoroughfare system.

Local Access Streets

This classification covers streets that have a primary purpose of providing access to the abutting property. This classification may be further classified as either residential, commercial and/or industrial depending upon the type of land use that they serve.

Due to the limited amount of detail that can be shown on a county thoroughfare plan, only urban major thoroughfares are shown.

Rural Classification

The facilities outside the urban thoroughfare planning boundaries make up the rural system. There are four major systems: principal arterials, minor arterials, major and minor collectors, and local roads.

Rural Principal Arterial System

This system is a connected network of continuous routes that serve corridor movements having substantial statewide or interstate travel characteristics. This will be shown by both the trip lengths and the travel densities. The principal arterial system should serve all urban areas of over 50,000 population and most of those with a population greater than 5,000. The Interstate system constitutes a significant portion of the principal arterial system.

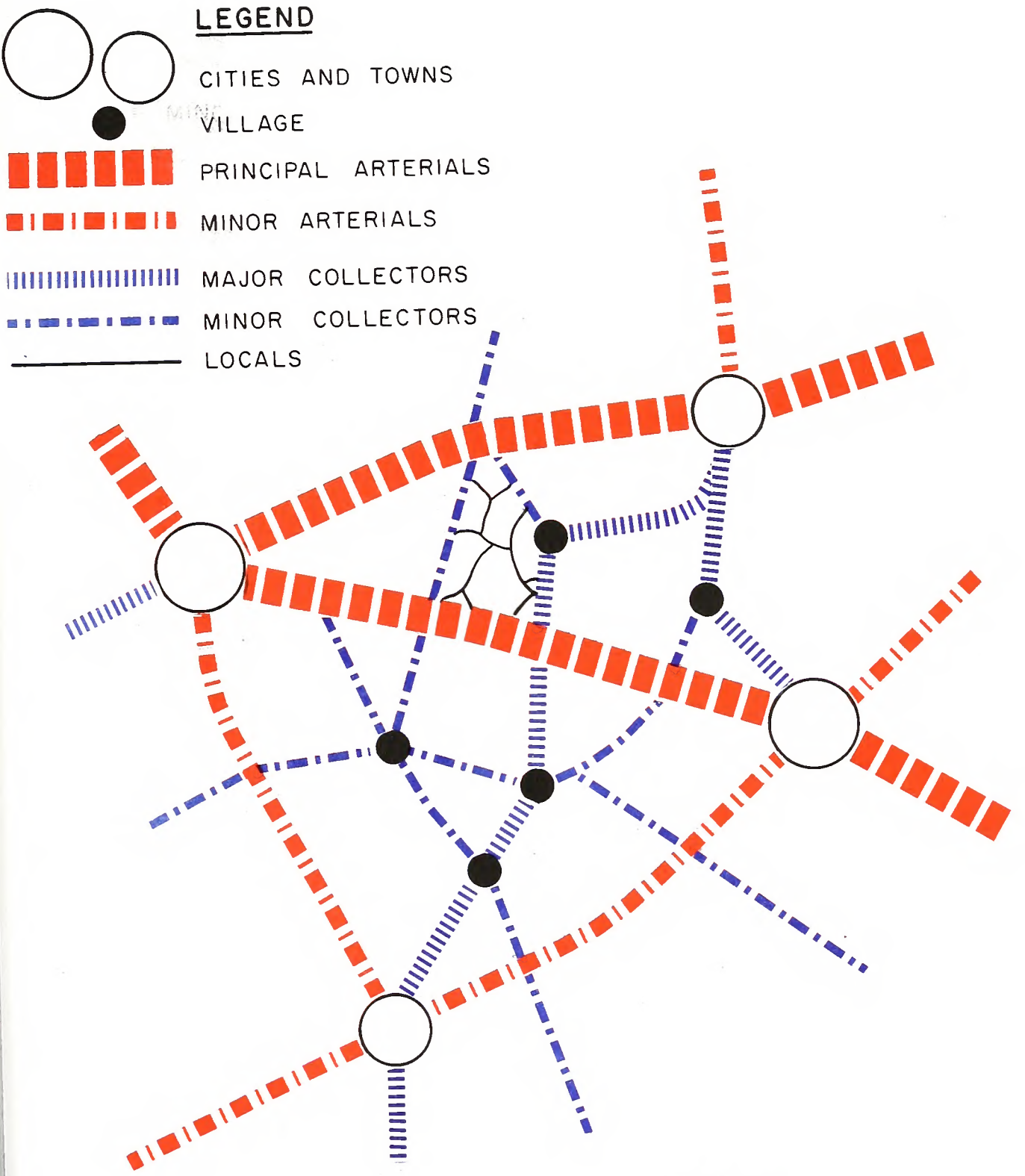


FIGURE 9

SCHEMATIC ILLUSTRATION OF FUNCTIONALLY CLASSIFIED RURAL HIGHWAY NETWORK

Rural Minor Arterial System

This system forms a network that links cities, larger towns, and other major traffic generators such as large resorts. The minor arterial system generally serves intrastate and intercounty travel and travel corridors with trip lengths and travel densities somewhat less than the principal arterial system.

Rural Collector Road System

The rural collector routes generally serve intracounty travel. These routes serve travel whose distances are shorter than on the arterial routes. The rural collector road system is subclassified into major and minor collector roads.

Major Collector Roads

These routes provide service to the larger towns not directly served by the higher systems and to other traffic generators of equivalent intracounty importance, such as consolidated schools, shipping points, county parks, significant mining and agricultural areas, etc. Major collector roads also link these places to routes of higher classification and serve the more important intracounty travel corridors.

Minor Collector Roads

These collect traffic from local roads and bring all developed areas within a reasonable distance of a major collector road. They also provide service to the remaining smaller communities and link the locally important traffic generators with the rural outskirts.

Rural Local Road System

The local roads are all roads that are not on a higher system. Local residential subdivision streets and residential collector streets are elements of the local road system. Local residential streets are either cul-de-sacs, loop streets less than 2,500 feet (762.2 m) in length, or streets less than one mile (1.6 km) in length. They do not connect thoroughfares or serve major traffic generators and do not collect traffic from more that one hundred dwelling units. Residential collectors serve as the connecting street system between local residential streets and the thoroughfare system.

Figure 9 gives a schematic illustration of a functionally classified rural highway system. The functional classification for Macon County is shown in Figure 2.

Objectives of Thoroughfare Planning

Thoroughfare planning is the process public officials use to assure the development of the most appropriate street system to meet the existing and future travel desires within the urban area. The primary aim of a thoroughfare plan is to guide the development of the street system in a manner consistent with changing traffic demands. Through proper planning for street development, costly errors and needless expense can be averted. A thoroughfare plan will enable street improvements to be made as traffic demand increases, and help eliminate unnecessary improvements. By developing the street

system to keep pace with increasing traffic demands, a maximum utilization of the system can be attained that will require a minimum amount of land for street purposes. In addition to providing for traffic needs, the thoroughfare plan should embody those details of good urban planning necessary to present a pleasing and efficient urban community. The location of present and future population, commercial and industrial enterprises, affects major street and highway locations. Conversely, the location of major streets and highways within the urban area will influence the urban development pattern.

Other objectives of a thoroughfare plan include:

- To provide for the development of an adequate major street system as land development occurs;
- To reduce travel and transportation costs;
- To reduce the cost of major street improvements to the public through the coordination of a street system with private action;
- To enable private interests to plan their actions, improvements, and development with full knowledge of public intent;
- To minimize disruption and displacement of people and businesses through long range planning for major street improvements;
- To reduce environmental impacts such as air pollution, resulting from transportation; and
- To increase travel safety.

These objectives are achieved through improving both the operational efficiency of thoroughfares, and improving the system efficiency by system coordination and layout.

Operational Efficiency

A streets operational efficiency is improved by increasing the capability of the street to carry vehicular traffic and people. In terms of vehicular traffic, a streets capacity is the maximum number of vehicles that can pass a given point on a roadway during a given period under prevailing roadway and traffic conditions. Capacity is affected by the physical features of the roadway, nature of traffic, and weather.

Physical ways to improve vehicular capacity include:

- **Street widening** - widening a street from two to four travel lanes can more than double the capacity of the roadway by providing the traffic with additional maneuverability

- **Intersection improvements** - increasing the turning radii, adding exclusive turn lanes, and channelizing movements can improve the capacity of an existing intersection

- **Improving vertical and horizontal alignment** - reduces the congestion caused by slow moving vehicles

- **Eliminating roadside obstacles** - reduced side friction and improves a driver's field of sight.

Operational ways to improve street capacity include:

- **Control of access** - a roadway with complete access control can often carry three times the traffic handled by a non-controlled access street with identical lane widths and numbers

- **Parking removal** - increases capacity by providing additional street width for traffic flow and reducing friction to flow caused by parking and unparking vehicles

- **One-way operation** - the capacity of a street can sometimes be increased 20-50%, depending upon turning movements and street width, by initiating one-way traffic operations. One-way streets also can improve traffic flow by decreasing potential traffic conflicts and simplifying traffic signal coordination

- **Reversible lanes** - reversible traffic lanes may be used to increase street capacity in situations where heavy directional flows occur during peak periods

- **Signal phasing and coordination** - uncoordinated signals and poor signal phasing restrict traffic flow by creating excessive stop-and-go operation.

Altering travel demand is a third way to improve the efficiency of existing streets. Travel demand can be reduced or altered in the following ways:

- **Carpools** - encourage people to form carpools and vanpools for journeys to work and other trip purposes; this reduces the number of vehicles on the roadway and raises the people carrying capability of the street system

- **Alternate modes** - encourage the use of alternate modes of travel such as transit, bicycles, or walking for short distance trips

- **Work hours** - encourage industries, business, and institutions to stagger work hours or establish variable work times for employees; this will reduce travel demand in peak periods and spread peak travel over a longer period

- **Land use** - plan and encourage land use development or redevelopment in a more travel efficient manner.

System Efficiency

Another means of altering travel demand is the development of a more efficient system of streets that will better serve travel desires. A more efficient system can reduce travel distances, time, and cost. Improvements in system efficiency can be achieved through the concept of functional classification of streets and development of a coordinated major street system.

Application of Thoroughfare Planning Principles

The concepts presented in the discussion of operational efficiency, system efficiency, functional classification, and the idealized major thoroughfare system are the conceptual tools available to the transportation planner in developing a thoroughfare plan. In actual practice, thoroughfare planning is done for established urban areas and is constrained by existing land use and street patterns, existing public attitudes and goals, and current expectations of future land use. Compromises must be made because of these and the many other factors that affect major street locations.

Through the thoroughfare planning process it is necessary from a practical viewpoint that certain basic principles be followed as closely as possible. These principles are listed below:

1. The plan should be derived from a thorough knowledge of today's travel - its component parts, and the factors that contribute to it, limit it, and modify it.

2. Traffic demands must be sufficient to warrant the designation and development of each major street. The thoroughfare plan should be designed to accommodate a large portion of major traffic movements on a few streets.

3. The plan should conform to and provide for the land development plan for the area.

4. Certain considerations must be given to urban development beyond the current planning period. Particularly in outlying or sparsely developed areas that have development potential, it is necessary to designate thoroughfares on a long-range planning basis to protect rights-of-way for future thoroughfare development.

5. While being consistent with the above principles and realistic in terms of travel trends, the plan must be economically feasible.

Table 10
Appendix B
Thoroughfare Plan Street Tabulation and Recommendations

FACILITY & SECTION	EXISTING CROSS-SECTION S.I. UNITS DIST km	RDWY m	ROW m	ENGLISH UNITS DIST MI	RDWY FT	ROW FT	NUMBER of LANES	PRACTICAL CAPACITY CURRENT (FUTURE)	1994 ADTS	2025 ADTS	RECOMMENDED X - SECTION RDWAY (ULT)	ROW (ULT)
US 19/74												
Swain Co. - Ball Road	0.48	9.75	18.29	0.30	32	60	3	12000	3000	5700	10.8	ADQ
Ball Road - 2.91 km north of Cherokee Co.	0.74	9.75	18.29	0.46	32	60	3	12000	3000	5700	10.8	ADQ
2.91 km north of Cherokee Co. - Cherokee County	2.91	6.10	18.29	1.81	20	60	2	9500	3000	5700	10.8	ADQ
US 23/441												
Georgia State Line - Poplar Grove Road	13.78	6.71	30.48	8.56	22	100	2	(40000)	6600	13500	(C)	ADQ
Poplar Grove Road - Franklin PAB (south)	4.26	19.51	30.48	2.65	64	100	2	(40000)	11500	22400	(C)	ADQ
Franklin PAB (north) - Jackson County	7.24	14.63	91.44	4.50	48	300	4	(40000)	9400	20300	ADQ	ADQ

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US 64												
Clay Co. - SR 1448	13.20	7.32	15.24	8.20	24	150	2	12000	1700	4100	ADQ	ADQ
SR 1448 - Franklin PAB (west)	5.47	14.63	15.24	3.40	48	150	4	40000	--	--	ADQ	ADQ
Bethel Church Road - Ellijay Rd	3.43	7.32	30.48	2.13	24	100	2	12000	6000	12700	C	ADQ
Ellijay Road - 290m Northwest of Walnut Creek Road	5.18	7.32	30.48	3.22	24	100	2	12000	2800	5900	7.2	UK
290m Northwest of Walnut Creek Road - Walnut Creek Road	0.29	6.71	30.48	0.18	22	100	2	11000	2800	5900	7.2	UK
Walnut Creek Road - Highlands PAB (west)	14.00	6.10	24.38	8.70	20	80	2	9500	2800	5900	7.2	UK
Highlands PAB (north) - Jackson County	4.83	6.71	24.38	3.00	22	80	2	11000	3200	7900	7.2	UK

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NC 28												
Georgia State Line - Highlands PAB (south)	6.58	6.10	30.48	4.09	20	100	2	9500	600	1200	ADQ	ADQ
Highlands PAB (west) - Bethel Church Road	Same as US 64 from Bethel Church Road to Highlands PAB (west)											
Franklin PAB (north) - Swain County	17.11	6.10	18.29	10.63	20	60	2	9500	3900	7600	7.2	30.0
NC 106												
Georgia State Line - Georgia State Line	1.13	7.32	30.48	0.70	24	100	2	12000	2800	5300	ADQ	ADQ
1.8 km section of facility in Georgia												
Georgia State Line - Highlands PAB (west)	13.74	6.10	18.29	8.54	20	60	2	9500	2900	5500	7.2	30.0

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Murphy Road (SR 1442)												
Franklin - Ball Road PAB (west)	1.74	6.10	18.29	1.08	20	60	2	9500	----	----	O	ADQ
Ball Road - US 64	0.37	6.10	18.29	0.23	20	60	2	9500	----	----	O	ADQ
Wayah BALD RD. (SR 1310)												
Murphy Road - West Edge of Wayah Game Refuge	15.45	4.88	UK	9.60	16	UK	2	6500	240	700	O	30.0
West Edge Of Wayah Game Refuge - Junaluska Road	14.00	5.49	30.48	8.70	18	100	2	8000	500	1500	O	ADQ
Junaluska Road - Winding Stairs Road	8.37	5.49	30.48	5.20	18	100	2	8000	300	900	7.2	ADQ
Winding Stairs Road - US 19/74	7.24	5.49	UK	4.50	18	UK	2	8000	400	1200	7.2	ADQ

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Dicks Creek Rd (SR 1401)												
Cherokee County - 2.57 km east of Cherokee County	2.57	5.49	30.48	1.60	18	100	2	8000	----	----	O	ADQ
2.57 km east of Cherokee County - Junaluska Road	5.95	6.10	30.48	3.70	20	100	2	9500	----	----	O	ADQ
Junaluska Road (SR 1400)												
Dicks Creek Rd - Ball Rd	0.97	6.10	30.48	0.60	20	100	2	9500	500	1500	O	ADQ
West Old Murphy Road (SR 1448)												
US 64 (west) - South Skeenah Road	11.27	5.49	12.19	7.00	18	40	2	8000	500	1200	6.6	18.0
South Skeenah Road - US 64 (east)	2.67	5.49	12.19	1.66	18	40	2	8000	----	----	6.6	18.0

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Ellijay Road (SR 1001)												
US 64 - Sugar Fork Road	1.26	4.88	UK	0.78	16	UK	2	6500	900	1700	O	18.0
Sugar Fork Road - Battle Creek Road	1.63	4.88	UK	1.01	16	UK	2	6500	900	1700	O	18.0
Battle Creek Road - Rock Branch Road	2.09	4.88	UK	1.30	16	UK	2	6500	600	1200	O	18.0
Rocky Branch Rd. - Little Ellijay Rd.	2.09	4.88	UK	1.30	16	UK	2	6500	----	----	O	18.0
Little Ellijay Road - Jackson County	8.85	4.88	UK	5.50	16	UK	2	6500	110	200	O	18.0
Mulberry Road (SR 1104)												
US 23/441 - Carpenter Rd	1.29	4.88	18.29	0.80	16	60	2	6500	250	?	6.0	ADQ

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Mulberry Road continued												
Carpenter Road - 1.6 km west of Carpenter Road	1.61	3.05	UK	1.00	10	UK	-	---	----	----	6.0	18.0
1.6 km west of Carpenter Road - Georgia State Line	5.47	3.66	UK	3.40	12	UK	-	---	----	----	6.0	18.0
Coweta Church Road (SR 1115)												
US 23/441 - Addington Bridge Road	0.32	5.49	UK	0.20	18	UK	2	8000	----	----	6.6	18.0
Addington Bridge Road (SR 1122)												
Coweta Church Road - Punch Bowl Road	1.93	5.49	UK	1.20	18	UK	2	8000	----	----	6.6	18.0

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South Skeenah Road (SR 1128)												
Skeenah Road - 480 m west of Newman Road	3.38	4.88	18.29	2.10	16	60	2	6500	800	1900	6.6	ADQ
480 m west of Newman Road - 160 m west of Jones Creek Road	1.77	5.49	18.29	1.10	18	60	2	8000	----	----	6.6	ADQ
160 m west of Jones Creek Road - SR 1448	3.06	5.49	UK	1.90	18	UK	2	8000	400	1000	6.6	18.0
Sanderstown Rd (SR 1335)												
NC 28 - Lyle Knob Road	2.90	5.49	12.19	1.80	18	40	2	8000	1400	3000	6.6	ADQ
Lyle Knob Rd - US 23/441	2.33	5.49	12.19	1.45	18	40	2	8000	1800	3900	6.6	ADQ

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Airport Road (SR 1434)												
NC 28 - 30 m west of Jones Road	2.45	5.49	UK	1.52	18	UK	2	8000	2100	3400	6.6	18.0
30 m west of Jones Road - Iotla Gap Road	1.29	5.49	UK	0.80	18	UK	2	8000	----	----	6.6	18.0
Iotla Gap Road (SR 1387)												
Airport Road - Middle Burnington Rd.	1.21	5.49	UK	0.75	18	UK	2	8000	500	800	6.6	18.0
Middle Burnington Road (SR 1372)												
Iotla Gap Road - Bennett Road	2.24	4.88	18.29	1.39	16	60	2	6500	1500	2400	6.6	ADQ
Bennett Road - NC 28	1.27	4.88	18.29	0.79	16	60	2	6500	1200	1900	6.6	ADQ

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Fulton Road (SR 1668)												
US 64 - Wills Grove Church Road	3.80	5.49	18.29	2.36	18	60	2	8000	500	1000	O	ADQ
Wills Grove Church Road (SR 1667)												
Fulton Road - McCoy Road	0.97	5.49	18.29	0.60	18	60	2	8000	----	----	O	ADQ
McCoy Road (SR 1653)												
Wills Grove Chruch Road - 145 m south of Wills Grove Church Road	0.14	6.10	30.48	0.09	20	100	2	9500	----	----	6.6	ADQ
145 m south of Wills Grove Church Road - Frazier Town Road	3.22	5.49	UK	2.00	18	UK	2	8000	1400	2800	6.6	18.0

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McCoy Road continued												
Frazier Town Road - Fulcher Town Road	0.97	5.49	18.29	0.60	18	60	2	8000	----	----	6.6	ADQ
Fulcher Town Road - Hickory Knoll Road	3.57	5.49	18.29	2.22	18	60	2	8000	600	1200	6.6	ADQ
Hickory Knoll Road (SR 1643)												
McCoy Rd - Tessentee Rd	4.18	5.49	18.29	2.60	18	60	2	8000	330	700	6.6	ADQ
Tessentee Road (SR 1636)												
Hickory Knoll Road - US 23/441	1.93	4.88	18.29	1.20	16	30	2	6500	1200	2400	6.6	18.0

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Mud Creek Road (SR 1628)												
NC 106 - Georgia State Line	0.48	6.10	18.29	0.30	20	60	2	9500	----	----	6.6	ADQ
End of Functionally Classified Roads												
Skeenah Road (SR 1127)												
Punch Bowl Road - South Skeenah Rd.	1.29	5.49	UK	0.80	18	UK	2	8000	----	----	6.6	18.0
Buck Creek Rd. (SR 1535)												
US 64 - Cold Mountain Rd	7.56	4.88	18.29	4.70	16	60	2	6500	400	1100	6.0	ADQ
Cold Mountain Road (SR 1538)												
Buck Creek Road - US 64	12.55	4.88	18.29	7.80	16	60	2	6500	----	----	6.0	ADQ

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Ball Road (SR 1625)												
NC 106 - Georgia State Line	3.06	4.88	UK	1.90	16	UK	2	6500	----	----	6.0	18.0
Norton Road (SR 1110)												
US 23/441 - 1.6 km west of US 23/441	1.61	4.88	UK	1.00	16	UK	2	6500	----	----	6.0	18.0
1.6 km west of US 23/441 - Buddy Gap Road	0.97	5.49	UK	0.60	18	UK	2	8000	----	----	6.0	18.0
Buddy Gap Road - Coweta Church Road	0.48	4.88	UK	0.30	16	UK	2	6500	----	----	6.0	18.0
Coweta Church Road (SR 1115)												
Norton Road - Addington Bridge Road	4.83	5.49	UK	3.00	18	UK	2	8000	----	----	6.6	18.0

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Tessentee Road (SR 1636)												
Hickory Knoll Road - 160 m west of Hickory Knoll Road	0.16	5.49	9.14	0.10	18	30	2	8000	----	----	6.6	18.0
160 m west of Hickory Knoll Road - Nichols Branch Road	7.56	5.49	18.29	4.70	18	60	2	8000	----	----	6.6	ADQ
Nichols Branch Road - Dead End	1.29	3.05	UK	0.80	10	UK	-	---	----	----	6.6	18.0
Prentice Road (SR 1649)												
US 23/441 - Teague Road	1.61	4.88	UK	1.00	16	UK	2	6500	----	----	6.0	18.0
Teague Road (SR 1651)												
McCoy Rd. - Prentice Rd.	0.50	4.88	UK	0.31	16	UK	2	6500	1100	2200	6.6	18.0

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Teague Road continued												
Prentice Road - Wide Horizon Road	1.00	5.49	UK	0.62	18	UK	2	8000	----	----	6.6	18.0
Wide Horizon Road (SR 1652)												
Teague Road - US 23/441	4.18	5.49	UK	2.60	18	UK	2	8000	----	----	6.0	18.0
Middle Burnington Road (SR 1372)												
Iotla Gap Rd. - Upper Burnington Rd.	4.35	4.88	UK	2.70	16	UK	2	6500	950	1500	6.6	18.0
Upper Burnington Rd - Byrd Road	6.12	5.49	18.29	3.8	18	60	2	8000	120	200	6.6	ADQ
Byrd Road - SR 1455	1.45	5.49	18.29	0.90	18	60	2	8000	470	1000	6.6	ADQ

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Tellico Road (SR 1455)												
Middle - NC 28 Burnington Road	1.61	6.10	45.72	1.00	20	150	2	9500	----	----	ADQ	ADQ
Walnut Creek Road (SR 1533)												
US 64 - Jackson County	9.98	5.49	18.29	6.20	18	60	2	8000	800	2300	6.6	ADQ
Charles Nolen Road (SR 1448)												
US 64 - US 64	1.13	4.88	UK	0.70	16	UK	2	6500	----	----	6.6	18.0

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C. Typical Cross Sections

Cross section requirements for thoroughfares vary according to the desired capacity and level of service to be provided. Universal standards in the design of thoroughfares are not practical. Each street section must be individually analyzed and its cross section requirements determined on the basis of amount and type of projected traffic, existing capacity, desired level of service, and available right-of-way. Typical cross sections recommended by the Statewide Planning Branch are shown in Figure 10. These cross sections are typical for facilities on new location and where right-of-way constraints are not critical. For widening projects and urban projects with limited right-of-way, special cross sections should be developed that meet the needs of the project.

The recommended typical cross sections shown in Appendix B, Table 10 were derived on the basis of projected traffic, existing capacities, desirable levels of service, and available right-of-way.

On all existing and proposed major thoroughfares delineated on the thoroughfare plan, adequate right-of-way should be protected or acquired for the ultimate cross sections. Ultimate desirable cross sections for each of the thoroughfares are listed in Appendix B. Recommendations for "ultimate" cross sections are provided for the following:

1. thoroughfares which may require widening after the current planning period

2. thoroughfares which are borderline adequate and accelerated traffic growth could render them deficient

3. thoroughfares where an urban curb and gutter cross section may be locally desirable because of urban development or redevelopment

Recommended design standards relating to grades, sight distances, degree of curve, super elevation, and other considerations for thoroughfares are given in Appendix D.

A - Four Lanes Divided with Median - Freeway

Typical cross section for four lane divided highways in rural areas which may have only partial or no control of access. The minimum median width for this cross section is 14 m (46 feet), but a wider median is desirable.

B - Seven Lanes - Curb & Gutter

This cross section is not recommended for new projects. When the conditions warrant six lanes, cross section "D" should be recommended. Cross section "B" should be used only in special situations such as when widening from a five lane section and right-of-way is limited. Even in these situations, consideration should be given to converting the center turn lane to a median so that cross section "D" is the final cross section.

C - Five Lanes - Curb & Gutter

Typical for major thoroughfares, this cross section is desirable where frequent left turns are anticipated as a result of abutting development or frequent street intersections.

D - Six Lanes Divided with Raised Median - Curb & Gutter / E - Four Lanes Divided with Raised Median - Curb & Gutter

These cross sections are typically used on major thoroughfares where left turns and intersection streets are not as frequent. Left turns would be restricted to a few selected intersections. The 4.8 m (16 ft) median is the minimum recommended for an urban boulevard type cross section. In most instances, monolithic median construction should be utilized due to greater cost effectiveness, ease and speed of placement, and reduced future maintenance requirements. In special cases, grassed or landscaped medians may be used in urban areas. However, these types of medians result in greatly increased maintenance costs and an increased danger to maintenance personnel. Non-monolithic medians should only be recommended when the above concerns are addressed.

F - Four Lanes Divided - Boulevard, Grass Median

Recommended for urban boulevards or parkways to enhance the urban environment and to improve the compatibility of major thoroughfares with residential areas. A minimum median width of 7.3 m (24 ft) is recommended with 9.1 m (30 ft) being desirable.

G - Four Lanes - Curb & Gutter

This cross section is recommended for major thoroughfares where projected travel indicates a need for four travel lanes but traffic is not excessively high, left turning movements are light, and right-of-way is restricted. An additional left turn lane would probably be required at major intersections. This cross section should be used only if the above criteria is met. If right-of-way is not restricted, future strip development could take place and the inner lanes could become de facto left turn lanes.

H - Three Lanes - Curb & Gutter

In urban environments, thoroughfares which are proposed to function as one-way traffic carriers would typically require cross section "H".

I - Two Lanes - C&G, Parking both sides ; J - Two Lanes - C&G, Parking one side

Cross sections "I" and "J" are usually recommended for urban minor thoroughfares since these facilities usually serve both land service and traffic service functions. Cross section "I" would be used on those minor thoroughfares where parking on both sides is needed as a result of more intense development.

K - Two Lanes - Paved Shoulder

This cross section is used in rural areas or for staged construction of a wider multi-lane cross section. On some thoroughfares, projected traffic volumes may indicate that two travel lanes will adequately serve travel for a considerable period of time. For areas that are growing and future widening will be necessary, the full right-of-way of 30 m (100 ft) should be required. In some instances, local ordinances may not allow the full 30 m. In those cases, 21 m (70 ft) should be preserved with the understanding that the full 30 m will be preserved by use of building setbacks and future street line ordinances.

L - Six Lanes Divided with Grass Median - Freeway

Cross section "L" is typical for controlled access freeways. The 14 m (46 ft) grassed median is the minimum desirable median width, but there could be some variation from this depending upon design considerations. Right-of-way requirements would typically vary upward from 70 m (228 ft) depending upon cut and fill requirements.

M - Eight Lanes Divided with Raised Median - Curb & Gutter

Also used for controlled access freeways, this cross sections may be recommended for freeways going through major urban areas or for routes projected to carry very high volumes of traffic.

N - Five Lanes/C&G, Widened Curb Lanes ; O - Two Lane/Shoulder Section; P - Four Lanes Divided/Raised Median, C&G, Widened Curb Lanes

If there is sufficient bicycle travel along the thoroughfare to justify a bicycle lane or bikeway, additional right-of-way may be required to contain the bicycle facilities. The North Carolina Bicycle Facilities Planning and Design Guidelines should be consulted for design standards for bicycle facilities. Cross sections "N", "O", and "P" are typically used to accommodate bicycle travel.

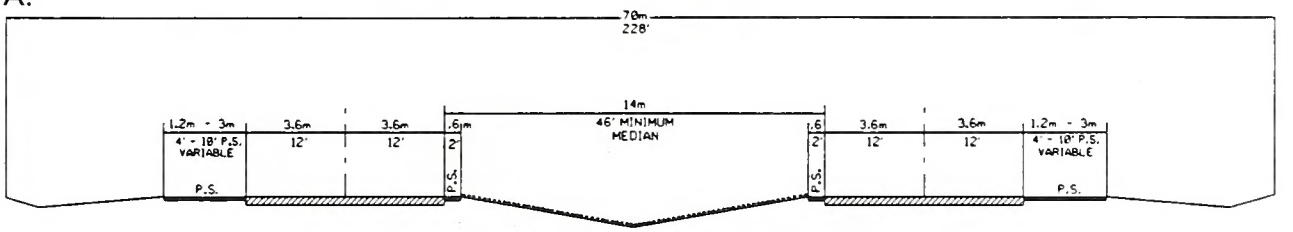
General

The urban curb and gutter cross sections all illustrate the sidewalk adjacent to the curb with a buffer or utility strip between the sidewalk and the minimum right-of-way line. This permits adequate setback for utility poles. If it is desired to move the sidewalk farther away from the street to provide additional separation for pedestrians or for aesthetic reasons, additional right-of-way must be provided to insure adequate setback for utility poles.

The right-of-ways shown for the typical cross sections are the minimum rights-of-way required to contain the street, sidewalks, utilities, and drainage facilities. Cut and fill requirements may require either additional right-of-way or construction easements. Obtaining construction easements is becoming the more common practice for urban thoroughfare construction.

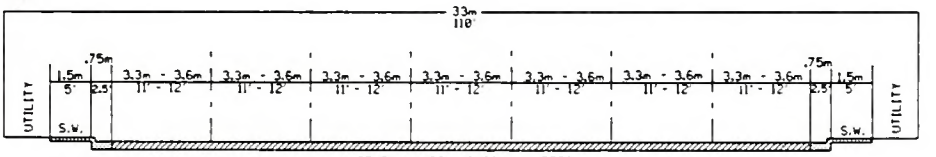
TYPICAL THOROUGHFARE CROSS SECTIONS

A.



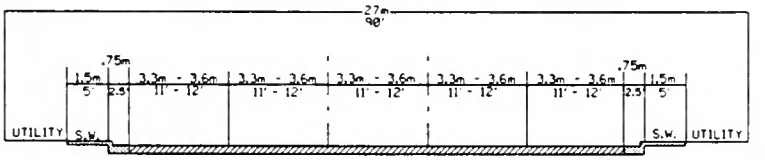
FOUR LANES DIVIDED WITH MEDIAN - FREEWAY

B.



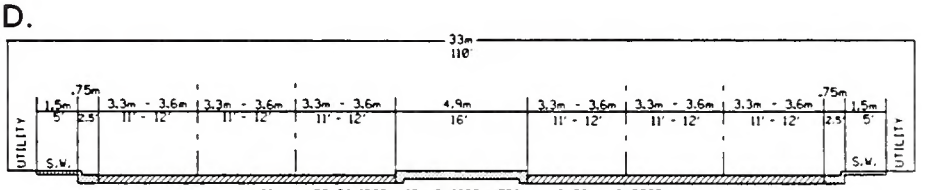
SEVEN LANES - CURB & GUTTER

C.



FIVE LANES - CURB & GUTTER

D.

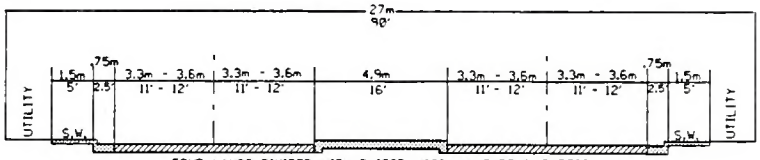


SIX LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

FIGURE 10

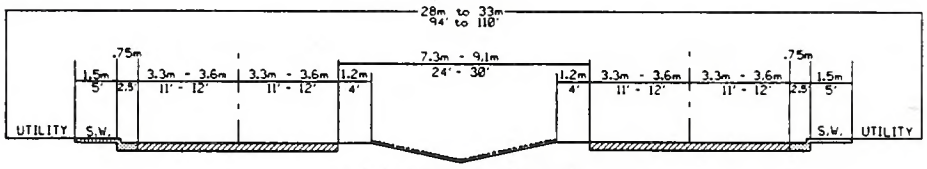
TYPICAL THOROUGHFARE CROSS SECTIONS

E.



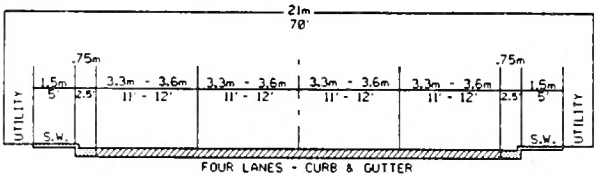
FOUR LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

F.



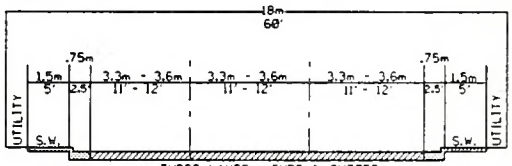
FOUR LANES DIVIDED - BOULEVARD
GRASS MEDIAN

G.



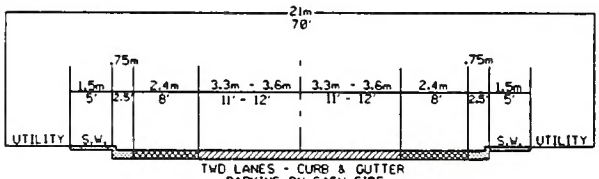
FOUR LANES - CURB & GUTTER

H.



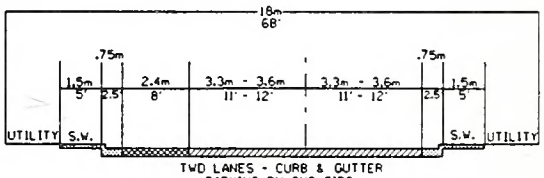
THREE LANES - CURB & GUTTER

I.



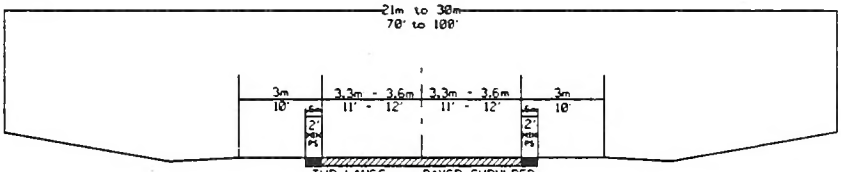
TWO LANES - CURB & GUTTER
PARKING ON EACH SIDE

J.



TWO LANES - CURB & GUTTER
PARKING ON ONE SIDE

K.

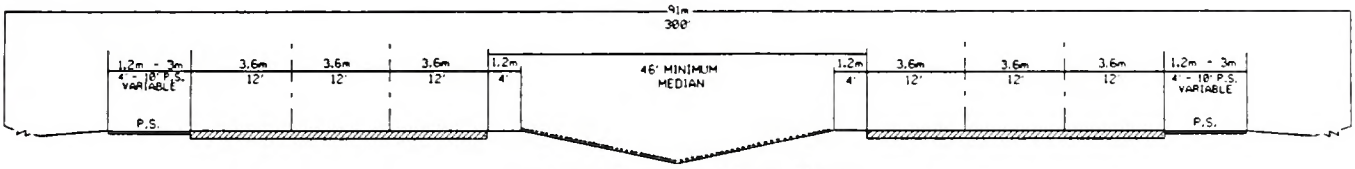


TWO LANES - PAVED SHOULDER

FIGURE 10

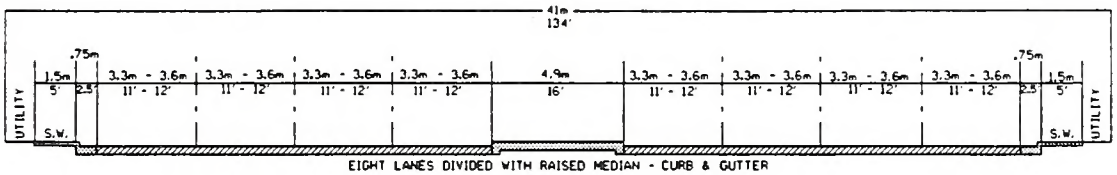
TYPICAL THOROUGHFARE CROSS SECTIONS

L.



SIX LANES DIVIDED WITH GRASS MEDIAN - FREEWAY

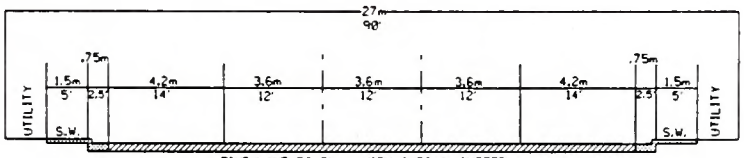
M.



EIGHT LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER

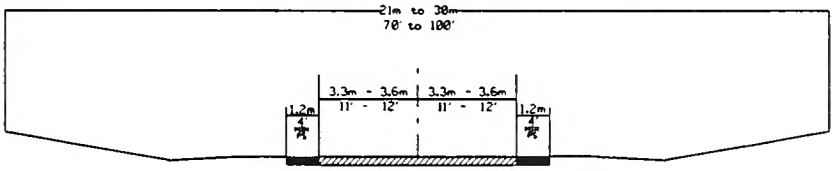
TYPICAL THOROUGHFARE CROSS SECTIONS FOR ACCOMMODATING BICYCLES

N.



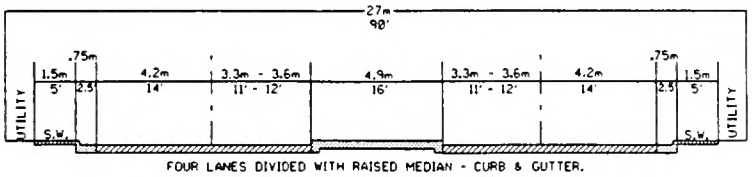
FIVE-LANE ROADWAY WITH CURB & GUTTER,
STANDARD INSIDE LANES & WIDENED CURB LANES

O.



TWO LANES - SHOULDER SECTION

P.



FOUR LANES DIVIDED WITH RAISED MEDIAN - CURB & GUTTER,
STANDARD INSIDE LANES & WIDENED CURB LANES

FIGURE 10

D. Recommended Subdivision Ordinances

Definitions

Rural Roads

1. *Principal Arterial* - A rural link in a highway system serving travel, and having characteristics indicative of substantial statewide or interstate travel and existing solely to serve traffic. This network would consist of Interstate routes and other routes designated as principal arterials.

2. *Minor Arterial* - A rural roadway joining cities and larger towns and providing intra-state and inter-county service at relatively high overall travel speeds with minimum interference to through movement.

3. *Major Collector* - A road which serves major intra-county travel corridors and traffic generators and provides access to the Arterial system.

4. *Minor Collector* - A road which provides service to small local communities and traffic generators and provides access to the Major Collector system.

5. *Local Road* - A road which serves primarily to provide access to adjacent land, over relatively short distances.

Urban Streets

1. *Major Thoroughfares* - Major thoroughfares consist of Inter-state, other freeway, expressway, or parkway roads, and major streets that provide for the expeditious movement of high volumes of traffic within and through urban areas.

2. *Minor Thoroughfares* - Minor thoroughfares perform the function of collecting traffic from local access streets and carrying it to the major thoroughfare system. Minor thoroughfares may be used to supplement the major thoroughfare system by facilitating minor through traffic movements and may also serve abutting property.

3. *Local Street* - A local street is any street not on a higher order urban system and serves primarily to provide direct access to abutting land.

Specific Type Rural or Urban Streets

1. *Freeway, expressway, or parkway* - Divided multilane roadways designed to carry large volumes of traffic at this speeds. A *freeway* provides for continuous flow of vehicles with no direct access to abutting property and with access to selected crossroads only by way of interchanges. An *expressway* is a facility with full or partial control of access and generally with grade separations at major intersections. A *parkway* is for non-commercial traffic, with full or partial control of access.

2. *Residential Collector Street* - A local street which serves as a connector street between local residential streets and the thoroughfare system. Residential collector streets typically collect traffic from 100 to 400 dwelling units.

3. *Local Residential Street* - Cul-de-sacs, loop streets less than 750 meters in length, or streets less than 1.5 kilometers in length that do not connect thoroughfares, or serve major traffic generators, and do not collect traffic from more than 100 dwelling units.

4. *Cul-de-sac* - A short street having only one end open to traffic and the other end being permanently terminated and a vehicular turn around provided.

5. *Frontage Road* - A road that is parallel to a partial or full access controlled facility and provides access to adjacent land.

6. *Alley* - A strip of land, owned publicly or privately, set aside primarily for vehicular service access to the back side of properties otherwise abutting on a street.

Property

Building Setback Line:

A line parallel to the street in front of which no structure shall be erected.

Easement:

A grant by the property owner for use by the public, a corporation, or person(s), of a strip of land for a specific purpose.

Lot:

A portion of a subdivision, or any other parcel of land, which is intended as a unit for transfer of ownership or for development or both. (Also includes "plat" and "parcel").

Subdivision

Subdivider:

Any person, firm, corporation or official agent thereof, who subdivides or develops any land deemed to be a subdivision.

Subdivision:

All divisions of a tract or parcel of land into two or more lots, building sites, or other divisions for the purpose, immediate or future, of sale or building development and all divisions of land involving the dedication of a new street or change in existing streets.

The following shall not be included within this definition nor subject to these regulations:

- The combination or re-combination of portions of previously platted lots where the total number of lots is not increased and the resultant lots are equal to or exceed the standards contained herein

- the division of land into parcels greater than four hectares where no street right-of-way dedication is involved

- the public acquisition, by purchase, of strips of land for the widening or the opening of streets

- the division of a tract in single ownership whose entire area is no greater than 0.8 hectares into not more than three lots, where no street right-of-way dedication is involved and where the resultant lots are equal to or exceed the standards contained herein.

Dedication:

A gift, by the owner, of his property to another party without any compensation being given for the transfer. The dedication is made by written instrument and completed with an acceptance.

Reservation:

Reservation of land does not involve any transfer of property rights. It constitutes an obligation to keep property free from development for a stated period of time.

Design Standards

Streets and Roads

The design of all roads within the Planning Area shall be in accordance with the accepted policies of the North Carolina Department of Transportation, Division of Highways, as taken or modified from the American Association of State Highway Officials (AASHTO) manuals.

The provision of street rights-of-way shall conform and meet the recommendations of the Thoroughfare Plan, as adopted. The proposed street layout shall be coordinated with the existing street system of the surrounding area. Normally the proposed streets should be the extension of existing streets if possible.

Right-of-way Widths

Right-of-way (ROW) widths shall not be less than the following and shall apply except in those cases where ROW requirements have been specifically set out in the Thoroughfare Plan.

Table 11
Minimum Right-of-way Requirements

Area Classification	*Functional Classification*	*Minimum ROW*
RURAL	Principle Arterial	Freeways -105 meters and Other - 60 meters
	Minor Arterial	30 meters
	Major Collector	30 meters
	Minor Collector	24 meters
	Local Road	18 meters[1]
URBAN	Major Thoroughfare	27 meters
	Minor Thoroughfare	21 meters
	Local Street	18 meters[1]
	Cul-de-sac	variable[2]

[1] The desirable minimum right-of-way (ROW) is 18 meters. If curb and gutter is provided, 15 meters of ROW is adequate on local residential streets.

[2] The ROW dimension will depend on radius used for vehicular turn around. Distance from edge of pavement of turn around to ROW should not be less than distance from edge of pavement to ROW on street approaching turn around.

The subdivider will only be required to dedicate a maximum of 30 meters of ROW. In cases where over 30 meters of ROW is desired, the subdivider will be required only to reserve the amount in excess of 30 meters. On all cases in which ROW is sought for a fully controlled access facility, the subdivider will only be required to make a reservation. It is strongly recommended that subdivisions provide access to properties from internal streets, and that direct property access to major thoroughfares, principle and minor arterials, and major collectors be avoided. Direct property access to minor thoroughfares is also undesirable.

A partial width ROW, not less than eighteen meters in width, may be dedicated when adjoining undeveloped property that is owned or controlled by the subdivider; provided that the width of a partial dedication be such as to permit the installation of such facilities as may be necessary to serve abutting lots. When the said adjoining property is subdivided, the remainder of the full required ROW shall be dedicated.

Street Widths

Widths for street and road classifications other than local shall be as recommended by the Thoroughfare Plan. Width of local roads and streets shall be as follows:

1. *Local Residential*

    - Curb and Gutter section

        - 7.8 meters, face to face of curb

    - Shoulder section

        - 6 meters to edge of pavement, 1.2 meters for shoulders

2. *Residential Collector*

    - Curb and Gutter section

        - 10.2 meters, face to face of curb

    - Shoulder section

        - 6 meters to edge of pavement, 1.8 meters for shoulders

Geometric Characteristics

The standards outlined below shall apply to all subdivision streets proposed for addition to the State Highway System or Municipal Street System. In cases where a subdivision is sought adjacent to a proposed thoroughfare corridor, the requirements of dedication and reservation discussed under Right-of-Way shall apply.

1. *Design Speed* - The design speed for a roadway should be a minimum of 10 km/h greater than the posted speed limit. The design speeds for subdivision type streets are shown in Table 12.

2. *Minimum Sight Distance* - In the interest of public safety, no less than the minimum sight distance applicable shall be provided. Vertical curves that connect each change in grade shall be provided and calculated using the parameters set forth in Table 13.

3. *Maximum and Minimum Grades*

    - the maximum grades in percent are shown in Table 14

    - minimum grade should not be less than 0.5%

    - grades for 30 meters each way from intersections (measured from edge of pavement) should not exceed 5%

4. *Superelevation* - Table 15 shows the minimum radius and the related maximum superelevation for design speeds. The maximum rate of roadway superelevation (e) for rural roads with no curb and gutter is 0.08. The maximum rate of superelevation for urban streets with curb and gutter is 0.06, with 0.04 being desirable.

Table 12
Design Speeds

Facility Type	*Desirable(km/h)*	*Minimum(km/h)*	
		Level	*Rolling*
Rural			
Minor Collector Roads	100	80	70
Local Roads	80	80	70
Urban			
Major Thoroughfares	100	80	80
Minor Thoroughfares	100	80	70
Local Streets	70	70	50

Table 13
Sight Distance

Design Speed (km/h)	*Stopping Sight Distance (meters)*		*Minimum K[1] Value*	
	Minimum	*Desirable*	*Crest Curve*	*Sag Curve*
30	30	30	3	4
50	60	70	10	12
60	80	90	18	18
90	140	170	71	40
100	160	210	105	51

NOTE: General practice calls for vertical curves to be multiples of 10 meters. Calculated lengths shall be rounded up in each case.

[1]K is a coefficient by which the algebraic difference in grade may be multiplied to determine the length in meters of the vertical curve which will provide the desired sight distance. Sight distance provided for stopped vehicles at intersections should be in accordance with "AASHTO, 1990".

Table 14
Maximum Vertical Grade

Facility Type and Design Speed (km/h)	*Maximum Grade in Percent*		
	Flat	*Rolling*	*Mountainous*
Rural			
Minor Collector[1]			
30	7	10	12
50	7	9	10
60	7	8	10
90	6	7	9
100	5	6	8
110	4	5	6
Local Roads[1]			
30	-	11	16
50	7	10	14
60	7	9	12
90	6	8	10
100	5	6	-
Urban			
Major Thoroughfares			
50	8	9	11
60	7	8	10
90	6	7	9
100	5	6	8
Minor Thoroughfares[1]			
30	9	10	12
50	9	9	10
60	9	8	10
90	7	7	9
100	6	6	8
110	5	5	6
Local Streets[1]			
90	-	12	17
30	8	11	15
50	8	10	13
60	7	9	11
100	6	7	-

[1] For streets and roads with projected annual average daily traffic less than 250 or short steep grades less than 150 meters long, grades may be 2% steeper than the values in the table.

Table 15
Superelevation

Design Speed (km/h)	*Minimum Radius at Maximum e*[1]		
	e=0.04	*e=0.06*	*e=0.08*
50	100	90	80
60	150	135	125
90	375	335	305
100	490	435	395

[1] e = rate of roadway superelevation, meter per meter

Intersections

1. Streets shall be laid out so as to intersect as nearly as possible at right angles, and no street should intersect any other street at an angle less than sixth-five degrees.

2. Property lines at intersections should be set so that the distance from the edge of pavement, of the street turnout, to the property line will be at least as great as the distance from the edge of pavement to the property line along the intersecting streets. This property line can be established as a radius or as a sight triangle. Greater offsets from the edge of pavement to the property lines will be required, if necessary, to provide sight distance for the stopped vehicle on the side street.

3. Off-set intersections are to be avoided. Intersections which cannot be aligned should be separated by a minimum length of 60 meters between survey centerlines.

Cul-de-sacs

Cul-de-sacs shall not be more than one hundred and fifty (150) meters in length. The distance from the edge of pavement on the vehicular turn around to the right-of-way line should not be less than the distance from the edge of pavement to right-of-way line on the street approaching the turn around. Cul-de-sacs should not be used to avoid connection with an existing street or to avoid the extension of an important street.

Alleys

1. Alleys shall be required to serve lots used for commercial and industrial purposes except that this requirement may be waived where other definite and assured provisions are made for service access. Alleys shall not be provided in residential subdivisions unless necessitated by unusual circumstances.

2. The width of an alley shall be at least six (6) meters.

3. Dead-end alleys shall be avoided where possible, but if unavoidable, shall be provided with adequate turn around facilities at the dead-end as may be required by the Planning Board.

Permits for Connection to State Roads

An approved permit is required for connection to any existing state system road. This permit is required prior to any construction on the street or road. The application is available at the office of the District Engineer of the Division of Highways.

Offsets to Utility Poles

Poles for overhead utilities should be located clear of roadway shoulders, preferably a minimum of at least 9 meters from the edge of pavement. On streets with curb and gutter, utility poles shall be set back a minimum distance of 1.8 meters from the face of curb.

Wheel Chair Ramps

All street curbs being constructed or reconstructed for maintenance purposes, traffic operations, repairs, correction of utilities, or altered for any reason, shall provide wheelchair ramps for the physically handicapped at intersections where both curb and gutter and sidewalks are provided and at other major points of pedestrian flow.

Horizontal Width on Bridge Deck

1. The clear roadway widths for new and reconstructed bridges serving 2 lane, 2 way traffic should be as follows:

- shoulder section approach
    - under 800 ADT design year - minimum 8.4 meters width face to face of parapets, rails, or pavement width plus 3 meters, whichever is greater
    - 800 - 2000 ADT design year - minimum 10.2 meters width face to face of parapets, rails, or pavement width plus 3.6 meters, whichever is greater
    - over 2000 ADT design year - minimum width of 12 meters, desirable width of 13.2 meters width face to face of parapets or rails
- curb and gutter approach
    - under 800 ADT design year - minimum 7.2 meters face to face of curbs
    - over 800 ADT design year - width of approach pavement measured face to face of curbs
- where curb and gutter sections are used on roadway approaches, curbs on bridges shall match the curbs on approaches in height, in width of face to face of curbs, and in crown drop. The distance from face of curb to face of parapet or rail shall be a minimum of 450 millimeters, or greater if sidewalks are required

2. The clear roadway widths for new and reconstructed bridges having 4 or more lanes serving undivided two-way traffic should be as follows:

- shoulder section approach - width of approach pavement plus width of usable shoulders on the approach left and right (shoulder width 2.4 m minimum, 3 m desirable)

- curb and gutter approach - width of approach pavement measured face to face of curbs

Metric Units

The following tables will be helpful to the reader in making conversions from the metric system into English units.

Table 16
Metric Conversion Table

English Units	*Metric Units*	*Abbreviation*
1 inch	25 millimeters	mm
1 foot	0.3 meters	m
1 mile	1.6 kilometers	km
1 acre	2.47 hectares	hect

Table 17
Metric Measurement Equivalents

Standard	*Equivalent*
1 millimeter	0.001 meters
1 kilometer	1000 meters
1 hectare	10,000 square meters